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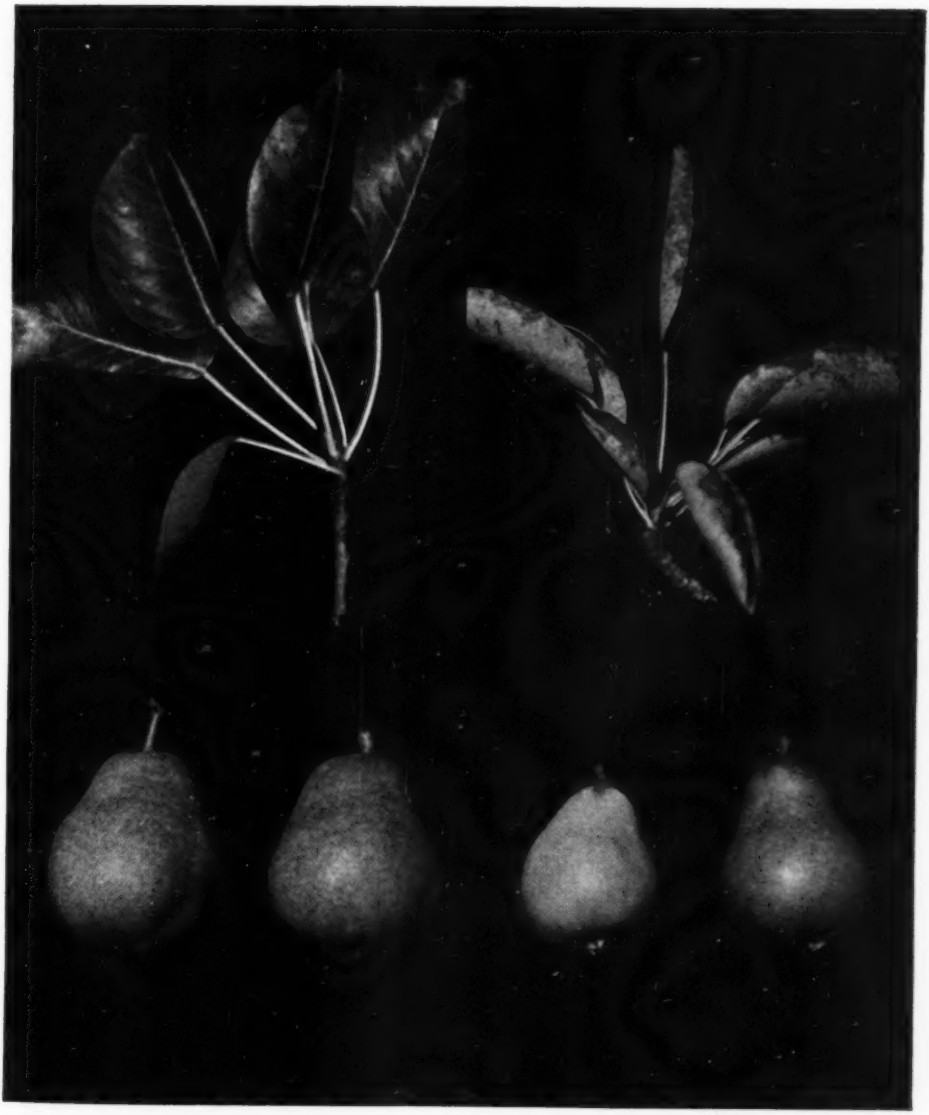

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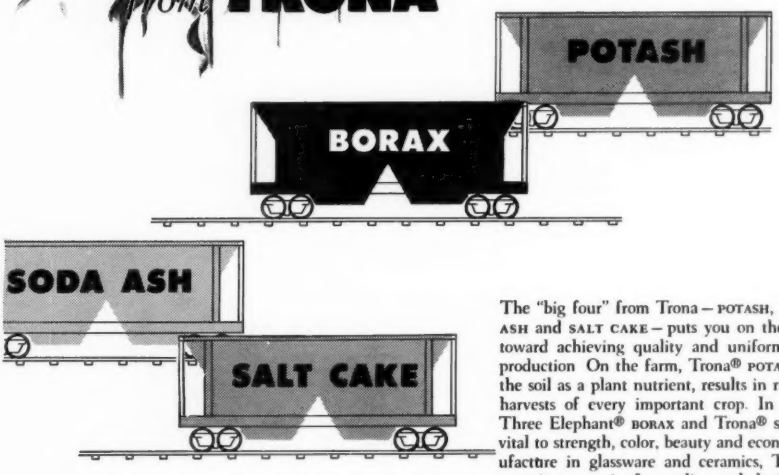

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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVIII NO. 9

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VOL. XXXVIII WASHINGTON, D. C., NOVEMBER 1954 No. 9

Well-managed . . .

Watersheds

Jeff McDermid

HAD you driven along a road near Kearney, Nebraska, about four years ago you'd have seen a certain half-section in a hilly, dryland farm of little value. Anyone could see that the farmer was having a tough time trying to meet his expenses, with little to show for his time. The 85 acres of more or less level land weren't getting much runoff from the surrounding hills, and the crops looked pretty frail. Probably the operator was lucky if he got a 20-bushel per acre yield of corn, and the livestock carrying capacity wasn't much over 20 head at best.

But if you drive past that farm today, you'll blink your eyes and wonder what became of the original scenery. There's still a farm within those same boundaries, but it's entirely different in many respects, having been transformed within the past three years by Mr. and Mrs. Gordon R. Danielson. They bought the place in 1950 and started to farm it in 1951. Danielson is a disabled veteran of World War I, and still draws his disability pension. However, his background is suitable, for he was born and raised on a farm.

They had some plans on the fire before they came. But they were short of finances to put them into effect. Most of their plans hinged on improved water and soil conservation systems, but they lacked the experience to begin irrigation farming in the right way.

Fortunately without too much trouble they found persons and agencies willing and ready to give both technical assistance and credit. Because the Danielsons did not have enough collateral to justify a loan from their local bank, it made them eligible for the

water facilities loans available from Farmers Home Administration. The FHA water facilities engineer, the county soil conservationist and his associate from the Buffalo-Ravenna soil conservation district, and the county supervisor for the FHA all joined in to help handle the situation.

Hence the plentiful water that now reaches those acres is not an accident. Careful surveying and planning by these cooperating agencies and the available loans did the trick. From a new irrigation well equipped with pump and power unit there flows about 1,000 gallons per minute. The 85 acres of level land are watered by gravity flow. Five miles of terraces are built and seeded grass waterways are in service. There is a small dam. With the terraces functioning, it is possible to irrigate the bottom land areas without flooding.

Danielson has furrowed the entire pasture on contour. He sowed 70 acres in alfalfa and 40 more to permanent pasture of brome, wheat grass, and sweet clover. Now his pasture carries 110 head of livestock, while his corn land is yielding from 70 to 90 bushels per acre.

This most unbelievable improvement was made possible when Danielson secured a loan of $5,400 in the fall of 1951—a water facilities loan from FHA. Thereupon he signed up under the Soil Conservation Service program and started in full tilt with his renovation and conservation plan.

THE water facilities loan program was at that time in effect only in 17 Western states, including Nebraska. Last summer Congress enacted a law which extends such facilities to all states and expanded the project to include loans which private banks may make to farmers, insured by FHA.

This is classified as Public Law 597, 83rd Congress. A companion law is also in force governing large areas in watersheds for conservation purposes. Thus we now have at the top the huge dams and large flood control works. In between, we have the watershed improvement law. Lastly, we have the provisions of the special act that deals solely with the matter of direct aid to individual farmers for conservation. Now, as far as laws ever solve things, we have at least the best chance we ever had to go forward on all fronts seeking to save our soils and water courses and to halt erosion and flood damage.

Public Law 566 of the 83rd Congress carries the provisions that interest thousands of land-owners who have their sights fixed on the future. Through this law local watershed groups may cooperate with and get help from the federal government in solving their flood prevention and water management programs. Local people are expected to do all they can on their own resources to get a start. They are supposed to ask the aid of the federal forces only for such parts of the venture they cannot dig up from local and state resources, in order to make the project click.

WHEN it was first announced, some folks rushed in to file their claims early—possibly imagining that this was another free homestead deal. One state filed over 100 watershed improvement projects at one lick. Too much is too much, so most of these paper projects got turned down and sent back. At least some careful preliminary planning and get-ready work must be furnished locally because the idea is not to have Uncle Sam saddle himself with a crazy quilt of boom-time bonanzas. If he did so and a lot of things went wrong in a hurry, what a juicy plum this would be for fence-mending political aspirants! What a chance to rave over all that "watered stock" and the blunders and bad management by the "bureaucratic hirelings." Neither is this law apt to be criticized because it overlaps or duplicates other existing national conservation efforts. This is because federal help under the new law is available only to help local organiza-

tions get systems of water management that cannot easily be set up and started under any other of the present federal conservation programs.

This is also important because among all the attacks launched by opponents of broad agricultural credit and engineering plans which have federal support, this charge of wasteful duplication of effort and funds is sometimes the one that is most often justified. There are indeed too many agencies and programs trying to do the same

thing—a situation quite human in its nature that is by no means confined to public affairs.

What is a "watershed?" is as good a question as any we can think of to bite into the meat of this matter. It may have different meanings but the actual wording of the law defines it as "all land and water within a natural drainage area of 250,000 acres, or less."

Certain works of improvement may be undertaken. Structural and land treatment measures used in flood prevention are allowed. Some agricultural phases that fit into the general plan for water conservation are included, and irrigation and drainage projects may be done.

Federal personnel will be given the right to assist the local soil conservation or flood control district in working out and testing the feasibility of a special work plan. The final installation of the flood prevention and water management features of the law will be furthered by the federal government's promise to pay over an equitable share of the costs. However, any water reservoirs which are not intended strictly for flood stopping must be built and paid for without recourse to the government for financial aid.

Before any appropriations are allowed by Congress to help build any watershed structural job of more than 2,500 acre-feet total capacity, the House and Senate agricultural committees must check and approve them. Anything of smaller size needs no prior approval. When it comes to the agricultural phases of assistance, the law says that these must always be irrigation and drainage projects which will benefit more than one farm. This is a watershed improvement deal and is not aimed at individual farm assistance. Here again the rule is that any water reservoirs built mainly for irrigation water storage cannot be paid for out of the federal budget.

Application blanks with suggestions for filling them out have been placed with certain offices close to the local areas. This would include the state agency which has been named by the governor to handle this work, as well as the nearest offices of the Soil Conservation Service, federal and state foresters, and agricultural extension. When filled in properly, these formal applications are sent to two places at the same time—the designated state agency and the SCS.

IT is impossible for the foresters or the soil conservationists to lift a finger towards direct aid for these groups until the state agency or the governor approves the application. In case there is no positive action taken by the state agency, 45 days must elapse before SCS can tackle any district's planning job. But, mind you, if the state agency or the governor rejects the application of any watershed group, there will be "nothing doing" by the

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DROUGHT

By Wm. A. Albrecht

Department of Soils, University of Missouri, Columbia, Missouri

WHEN we keep breaking heat records, and when droughts are being classified as national emergencies, it seems appropriate to make some observations on the crop disasters under what is commonly called "drought." We may well study some of the factors concerned beside the weather records and the meteorological parameters. In place of using these extended rain-free periods as the alibi, perhaps a more complete analysis of the situation will exhibit the soil as a contributing factor. Perhaps through it there may be some means of mitigating the disastrous effects associated with what is commonly called "drought."

Some geographic characters of the droughts suggest that they are highly continental. Within larger land bodies, the unexpected weather comes more often. That is another way of saying that the weather records for certain short periods may vary widely from the climate, or from the average figures for extended times. As an illustration, Columbia, Missouri, had an annual rainfall in 1953 of only 25.12 inches in place of 39.33 inches, or what was the average of over more than a half century, and what was considered "the normal." The rainfall of the year 1953 was 36.1% below normal (assuming that "the normal" hasn't gone lower, too). Accordingly, we may expect rainfall to go above normal by that figure some of these days. This, then, tells us that the continental effect may amount to that much above or that much below "the normal." It may be a variation totaling 72.2% of "the normal." Thus, we have had in 1953 what amounts to a continental effect of 72.2% or a new record of continentality as well as a new record of low rainfall.

The variations in temperatures from the mean, and the long periods without rainfall or the drought, must be put into that category of continentality along with the variation in inches of annual precipitation. Droughts, then, which involve both high temperatures and extended rain-free periods, become disasters because (a) longer periods between rainfalls represent soils dried to greater depths, (b) soils have less and less water evaporating from them directly and from the vegetation growing on them to spend the sun's heat in vaporizing it, and (c) the atmospheric temperature rises high enough thereby to injure the plant tissues because of the record heat wave.

Fertile Soils Make Stored Water Efficient in Crop Production to Lessen Drought Disaster

Sanborn Field with its shallow but fertile surface soil over the infertile clay subsoil, which characterizes the Putnam silt loam, illustrated well the drying of the soil to great depths of its profile. Water exhaustion of the soil to near the permanent wilting point of the crop went deeper and deeper as the corn roots, for example, were marching downward like an army for more water. On their leaving the fertile surface soil exhausted of water, and on entering the infertile subsoil for the stored water there, the lower leaves of the corn plants were "fired." This yellowing of those older leaves represents a case of robbing them of their nutrients for the survival of the younger, growing top leaves. It reports the decided shortage in delivery of fertility brought on by the transition of the roots from one fer-

Fig. 1. Drought damage suggests itself as heat damage to plant's more active growth processes. Representative samples from Sanborn Field, late July 1954. Center—no soil treatment, corn continuous since 1888, lower two leaves "fired," leaves rolled, none bleached white. Left—Six tons manure, corn continuous since 1888, five lower leaves "fired," leaves rolled, none bleached white. Right—soil treated according to test, two tons stalks under, continuous corn, one lower leaf "fired," younger leaves rolled, older leaves bunched on stalk, bleached white from tip to mid-leaf.

tile soil horizon to the other less fertile. But the growing leaves at the top of the plants did not necessarily wilt. That fact tells us that the "firing" is not due to a water shortage. It is the wilting of the growing tip of a plant that tells us when a plant needs water, as every woman keeping house plants knows very well.

Data from the Soil Conservation Research project at McCredie during the summer drought of 1953 showed the corn crop exhausting the soil moisture to a depth of 3.5 feet under the fertilized soils. The equivalent of only 1.04 inches of water was left in that entire depth. Where the soil was not fertilized, the crop dried out the soil to a lesser depth. It left the equivalent of 4.5 inches of water in the upper 3.5 feet. On the unfertilized corn, which took 14 inches of water from the soil, the yield was only 18 bushels per acre. It required 26,000 gallons of water to make a bushel of corn. On the fertilized soil with a yield of 79 bushels, only 5,600 gallons of water per bushel were required. The drought was a case of plant hunger rather than thirst.

This was a clear demonstration that the soil is a factor in the drought, not through differences in the stored water in this case, but rather as it represents fertility by the management of which the specific supply of rain water can be made to yield so much more in crop returns. It suggests the possibility of more fertility to greater depths of the soil as the way to use stored water more efficiently. We need not only to store water to greater depths but to store fertility to such depths also. The drought drying the soil down to 42 inches and spending 16 inches of stored soil water to give 79 bushels of corn certainly would be considered much less of a "disaster" or of an "agricultural emergency" than the drying of it to only about 36 inches and spending 14 inches of soil water but getting only 18 bushels for that cost in water. Unfortunately, the rainfalls after the drought of the

summer of 1953 and before the summer of 1954 were not sufficient to restore the moisture in the soil to those depths of its previous drying. As a consequence, the drought of 1953 carried over into the succeeding year.

Corn Plants Making No Grain On Infertile Soil Showed No Visible Injury By The Heat Waves

During the drought of 1954 the different levels of soil fertility represented by the plots on Sanborn Field suggested forcefully that the drought may be injurious to plant processes because of high temperatures. It suggested also a more severe injury to plant tissues according as the higher soil fertility represented more actively growing plants.

Where corn has been grown continuously since 1888 with crop removal and no soil treatment, the plants remained greenest of all corn plots on the entire field. Only the lower two leaves on the stalks were "fired." The other eight leaves, though much rolled, showed no irregularities. The stalks were tassled but were without shoots. One would say it was about the customary "short" crop which that plot has been growing regularly now for many years.

On the adjoining plot where six tons of manure per acre have been used annually, the much taller and heavier stalks had the lower five leaves badly "fired." The remaining six leaves were rolled. But they were not visibly injured. The stalks were well tasseled. The plants were without shoots, suggesting no grain production.

On the nearby plot where heavy crop residues were turned under and the soil given full fertilizer treatment—including nitrogen—only a single lower leaf was "fired." The other 13 or more leaves were closely bunched on the shortened stalk. The tassel had not emerged. There were no shoots or signs of ears. More significant, however, was the observation that the leaves were badly bleached from their tips back to almost their mid-length. This part of the leaf tissue was dead. Save for its widely different appearance, the damage took a pattern suggesting the same leaf area involved when the plant suffers from nitrogen deficiencies in the soil. It suggested death in the area where the extra nitrogen was involved in growth rather than where there was a deficiency.

When the more vigorous plant growth for seed production involves more physiological functions, it seems reasonable that high temperatures might be more disturbing to the living processes centered in the expectably higher protein content of the cells than to those in plants growing less vigorously and doing little more than making the minimum of carbohydrates, like starch and cellulose. Processes of growth and life are activated by enzymes, compounds resembling proteins in some respects. They are decidedly thermolabile, or are killed by temperatures going above 45°C or 113° F. The proteins of vigorously growing plants may not be so widely different in their responses to high temperatures than are fertile eggs under incubation. Eggs give a good hatch when the temperature is held at 100° F. But a few hours of 10° F. above that temperature will ruin the hatch even if the egg protein is not coagulated or even coddled. No visible signs of injury are recognized until the egg really dies and processes of change or decomposition have had time to give their evidence. The death of the corn leaf under the high temperature of heat wave suggests a close similarity, and time is required for the disturbed plant metabolism to indicate itself as may be suggested by accumulation of nitrates to the danger point as poison for animals consuming the green fodder. One may well be reminded that crops growing in the tropical heat are not high producers of protein.

Droughts are disasters to crops because they are more than shortages of water per se. They are disasters because they are (a) shortages of soil fer-

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Fertilizers Increase Yield and Protein Content of Corn Forage in Illinois

By W. B. Nevens

Department of Dairy Science, University of Illinois, Urbana, Illinois

INCREASED yields and improved feeding value of the forage were brought about by the application of fertilizers to silage corn when the crop was grown on soils low in available plant food. These results were obtained in a carefully conducted 5-year experiment at the Illinois Station.

The corn was grown on two fields which differed greatly in their productivity. The field used during the first three years had received frequent, heavy applications of barnyard manure and also had frequently been an alfalfa meadow. The field used during the last two years of the trials was operated for many years in a cash-grain system of farming. The productivity of the latter field was relatively low.

The method of planting and the hybrids used were the same in each of the five years. There were eight replicated blocks, each containing four rows of each of five hybrids. The corn was drilled in rows 40 inches apart and spaced to give a population of 11,000 to 12,000 plants to the acre. Blocks treated with fertilizer were alternated with untreated blocks. The hybrids selected for the test had been shown by previous investigation to be adapted to east-central Illinois for both silage and grain production. They were Illinois Hybrids 206, 784, 972A-1, 2119 (W), and U.S. 13.

Two hundred pounds of an 8-8-8 fertilizer were applied to the plots at planting time and 200 pounds of either ammonium nitrate or ammonium sulfate fertilizer were used as a sidedressing at the last cultivation. In the first year the treatments were slightly different, the amounts applied being 300 and 150 pounds, respectively.

Because of the rapid increase in the yield of grain from the time of ear for-

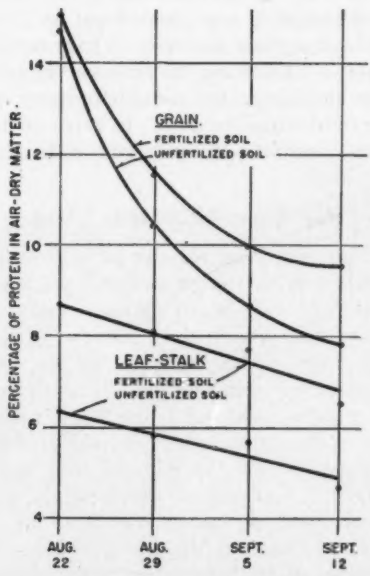

Fig. 1. The percentage of protein in both the grain and leaf-stalk fractions of the forage declined rapidly prior to silo filling. When the corn crop was grown on poor soil, fertilizer applications caused an increase in the protein content of the leaf-stalk portion but in only one year was the protein content of the shelled corn enhanced by such treatment.

Fig. 2. Increases of as much as four tons of fresh corn forage (silage) were obtained when a poor soil was given fertilizer treatment. Left, untreated soil; right, fertilized soil.

mation up to full maturity of the ears, field sampling was carried out at 7- to 10-day intervals for three to four weeks prior to harvesting the crop for the silo. The yields reported are chiefly based on the field-sampling data. In three of the years complete harvest data were also obtained.

Fertilizer Increased Yield

The corn crop reaches its maximum yield of fresh forage at about the time when the ears begin to form (shoot). From that period up to harvest for the silo, there is little change in the tonnage of harvested forage. If permitted to stand beyond the silage stage, ripening of the forage brings about a gradual decline in the weights of the fresh forage. Analyses of the forage, however, show a remarkable build-up of dry substance in the forage while the amount of fresh forage remains almost stationary, that is, during the three to four weeks prior to silo filling. This increase is chiefly caused by the growth of ears. In east-central Illinois, ear formation begins about August 1. By September 10 to 20 the ears have increased to such an extent that they form 40 to 50 per cent of the forage (dry-matter basis).

To determine the effect of fertilizer on yields, therefore, studies were made of the weights of fresh forage, dry matter in forage, and proportion of ears in the forage throughout the three to four weeks prior to silage harvest. Thus the findings were not based upon a single harvest figure but upon a series of weights and analyses of harvests from the same plots.

The fertilizer treatments in the first three years during which the forage was grown on a highly productive field caused relatively small increases (about eight per cent) in yields of fresh forage. The average figures for three sampling harvests in each of the three years were 14.5 tons per acre from the unfertilized blocks and 16.2 tons from the fertilized blocks. The yields of dry matter in the forage were also about eight per cent larger from the fertilized blocks. From a statistical standpoint the differences were not significant. During the two years when the crop was grown on an impoverished soil, the picture was quite different. Fresh forage yields on the unfertilized land averaged 12.2 tons per acre and from the fertilized land 16.5 tons. This was an increase of about 35 per cent. The increases in dry-matter yields were about in line with those for fresh forage. Average dry-matter yields for three sampling harvests in each year were 5,600 pounds per acre from the unfertilized blocks and 7,500 pounds from the fertilized blocks, a difference of about 34 per cent. The complete harvest data for the two years when the crop was grown on poor soil showed an increase of approximately 37 per cent in yields as a result of fertilizer treatment.

The yield difference between the unfertilized and fertilized blocks in the last two years was highly significant and appears to be a direct result of fertilizer treatment.

Part of Crop Formed By Ears

Did fertilizer treatment increase only the grain (ears), the leaf-stalk fraction, or both grain and forage? To answer this question the proportion of the crop formed by ears was computed from the sampling data. It was found that the percentage of the dry matter of the crop which consisted of ears was practically the same for both the unfertilized and the fertilized crops in four of the five years. In one year the fertilized crop had a higher proportion of ears. It appears, therefore, that in four of the five years the larger yield of forage from the fertilized corn as compared with the unfertilized crop was accounted for by larger amounts of stalks and leaves as well as ears. This finding is of interest to the farmer who questions the desirability of applying fertilizer to silage corn.

Even though the proportion of ears in the forage of the unfertilized and the fertilized corn was practically the same, there was a rapid increase in the amount of ears in the forage during the three to four weeks covered by the sampling harvests. In one year the ears comprised 11 per cent of the dry matter of the unfertilized corn on August 28, the first sampling date, but by September 22 this proportion had risen to 48.9 per cent. In the fertilized corn the figures for the same dates were 11.8 per cent and 47.8 per cent, respectively.

Fertilizer Increased Leaf-Stalk Fraction

In addition to the indirect evidence supplied by calculating the proportion of the crop formed by ears, direct tabulation of the yield data showed that more forage in the form of leaves and stalks was grown on the fertilized than on the unfertilized blocks. The difference was significant in two years and highly significant in two other years. Thus an abundance of evidence that application of fertilizer was responsible for increases in yields of both the ear and leaf-stalk fractions of the corn forage was obtained, particularly in the last two years when the crop was grown on a field low in productivity.

In contrast to the rapid build-up of dry matter in the ears and stalks, the dry-matter yield of the leaf-stalk fraction remained practically stationary dur-

Fig. 3. When the corn was grown on a poor soil, sidedressing with a nitrogen fertilizer helped to increase yields of forage and the protein content of the leaves and stalks.

ing the three to four weeks prior to silo filling.

During the last three years of the trials, samples of shelled corn and of the leaf-stalk fraction were obtained from each of the four hybrids grown in four replicated blocks on unfertilized land and four replicated blocks on fertilized land. These samples were tested for total protein and part of them were also analyzed for fiber content. For all hybrids in each of the three years, the protein content of the shelled corn declined markedly from the first to the final harvest. While such a decline is known to be characteristic of the growth and development of the corn plant, it is often overlooked by those who seek to compare the protein content of one hybrid with that of another or a corn crop grown under a particular set of conditions with a crop grown under different conditions. A valid comparison must take into consideration the stage of development of the crop.

Application of fertilizers did not bring about an increase in the protein content of the shelled corn in the year in which the crop was grown on highly productive soil. In fact, the protein content of the unfertilized corn was higher than that of the fertilized corn. In one of the two years in which the crop was grown on a poor soil, the results were also contrary to expectations, that is, the ears of unfertilized corn had the higher protein content. In the other year, during which the plots were located on poor soil, the protein content of the shelled corn grown on fertilized land was significantly higher than that of corn grown on unfertilized land. Because the plots in both years in which the crop was grown on poor soil were on the same field, it seems likely that the difference in protein content is to be attributed to seasonal effects rather than to fertilization alone. Evidently in one year seasonal conditions enabled the crop to respond to fertilizer treatment, while in another year such conditions were not experienced.

Boosts Protein of Leaf-Stalk Fraction

When the forage was grown on the highly-productive soil, the protein content of the leaf-stalk fraction of the unfertilized crop was significantly higher than the protein content of the fertilized crop. On the other hand, in the two years in which the corn was grown on poor land, the protein content of the leaf-stalk fraction of the fertilized crop was higher than that of the unfertilized. This difference was found to be highly significant.

The protein content of the leaf-stalk portion of the forage declined during the period of observation in much the same manner as did the ear fraction although the rate of decline was not quite so rapid. Here, too, a valid comparison must take into consideration stage of development and is best based upon determinations made over a period of several weeks.

Fiber Content Not Changed

As already pointed out, the extra yield from the fertilized plots was found to consist not only of ears but also of a proportionately greater yield of leaves and stalks. There was no change in rate of planting. Hence, to bring a larger yield, the plants must have been larger. Were these larger plants of the fertilized crop more fibrous and thus less nutritious than the plants of the unfertilized corn?

To answer this question, samples of the leaf-stalk fraction of the forage of each of the five hybrids grown in four unfertilized blocks and four fertilized blocks from three field-sampling harvests and of the forage from the complete harvest of one season were analyzed for their fiber content. The differences between the fiber contents of the forage of the unfertilized and fertilized crops were small and there was no evidence to indicate an increase in fiber content because of fertilization.

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Soil Tests Are Influenced by Field Conditions and Sampling Methods

By E. M. Dunton, Jr., Margaret E. Taylor, and R. B. Hall[1]

Virginia Truck Experiment Station, Norfolk, Virginia

SOIL testing has been a service of the Virginia Truck Experiment Station for at least 19 years, and is now well established as a means of determining the fertilizer and lime needs of coastal plain soils. The tests have been of invaluable assistance in diagnosing nutrient deficiencies as they occur in the field and, in some cases, nutrient excesses where too much lime and fertilizer have been applied. In some of the field problems studied, the soil tests have shown that plant symptoms are not always clear-cut indications of the soil trouble. The soil test itself is also not infallible, and one of the purposes of this paper is to point out some of the limitations of the tests and precautions to observe in sampling soils for quick tests and interpretation of the reports.

The county agricultural worker's responsibility in seeing that soil samples are properly taken, that samples are taken on fields where the test will actually assist the farmer, and that the correct interpretation of the test is made to the farmer, is equally as important in soil testing work as the analyses of the soil testing laboratory. A soil sample improperly taken or a fertilizer or lime recommendation improperly made can render a soil test a disservice to the farmer. It is the Station's duty to make the soil test as accurate and reliable as possible while it should be the duty of those who make lime and fertilizer recommendations to the farmer, whether it is the agricultural specialist or the soil test laboratory, to be sure that the recommendation is the one best fitted to the particular condition.

The individual making the recommendations should know the fertilizer and lime levels best suited for a particular crop and the nature of the soil to which they are to be applied. For this we believe it is necessary that he have at least a fair understanding of the soil test procedure and the limitation of the tests, and preferably to have conducted some field tests on high and low fertility soils with the major crops of the region, and to know the importance of obtaining representative samples. He should also have close association with the farmer to know the history and characteristics of the fields for which the test is run.

Soil Sampling

Taking the soil sample is the first step and a very important one in the soil testing procedure. The person taking the sample should have the purpose of the sampling in mind and an understanding of what field factors might result in an erroneous picture from the soil test report. As an example of this, most fertilizers have a marked influence on temporarily increasing the soil acidity. If fertilizers have been recently added to the field,

[1] Soil Technologist, Analyst, and Assistant Soil Technologist, respectively.

it is impossible to get a uniform sample of the soil. For this reason, to get the basic information on the fertility level and lime needs of the soil, fields should be sampled in winter or early spring before the spring fertilizers are added. Samples may be taken during the growing season to check nutrient deficiencies or at harvest time to check the presence of residual material. It is also difficult to get a uniform sample with respect to soil reaction when lime has been applied in the past few years.

All types of liming materials quickly change the soil reaction of our coastal plain soils, but they must be uniformly distributed through the surface layer for the soil test to give a representative picture of the reaction. This mixing under farm field conditions may take several years. This is not necessarily a disadvantage and may even be an advantage in that there will be in the soil areas of variable reaction. Thus the use of common sense and due consideration to the purpose of the test and the information desired are of more importance than trying to follow an exact procedure for all sampling. The past treatment or history of the field is an important factor.

The number of individual samples taken for each composite sample will vary with the size of the field. Ten to fifteen should be a minimum. The number of composite samples taken should vary with the size and variability of a field. If the field is five acres or more, or has been variably treated in the past, more than one composite should be taken. If a field is being sampled for the purpose of determining why crops are not growing well, samples should be collected from the good and bad areas and preferably two composite samples taken from each area. If the samples mailed in for testing are taken from an area where a soil problem is involved, a description of the problem should be included with the sample. Certain problems require special tests not run on all samples.

If a 6- or 8-inch trowel is used for taking the individual samples to make up the composite, it should be pushed down into the soil as far as possible and an approximate ½-inch slice of the surface soil obtained.

Field Conditions at Time of Sampling

The moisture conditions of the soil at time of sampling influence some of the soil tests. This influence is not due so much to the actual water in the

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TABLE I.—PER CENT MOISTURE IN SOIL AT TIME OF SAMPLING AS IT INFLUENCES THE SOIL TEST

Date of sampling	% water in soil	Condition of soil	pH	Phosphorus*	Potassium*	Nitrate*	Salt Conc.**
5/29/50	18.7	Soggy wet	5.6	20.6	92	55	73
6/12/50	7.2	Dry on top	5.5	17.0	51	91	120
6/26/50	4.7	Very dry	5.5	20.8	276	100	116
7/10/50	14.0	Very wet	5.6	15.9	59	17	48
7/24/50	10.7	Moist, excellent condition to cultivate	5.5	12.8	56	68	73
10/30/50	8.2	Moist, dry on top	5.4	18.9	120	108	130
11/13/50	7.7	Moist, have had extended dry period	5.4	21.6	145	125	120
11/27/50	14.6	Too wet to cultivate	5.4	19.5	150	136	125
12/11/50	16.4	Too wet to cultivate	5.6	20.1	145	33	55
1/ 2/51	15.3	Too wet to cultivate	5.6	19.2	124	50	73

* Parts per million in air dry soil.

** Micromhos (Specific conductance), with a soil-water ratio of 1:1.

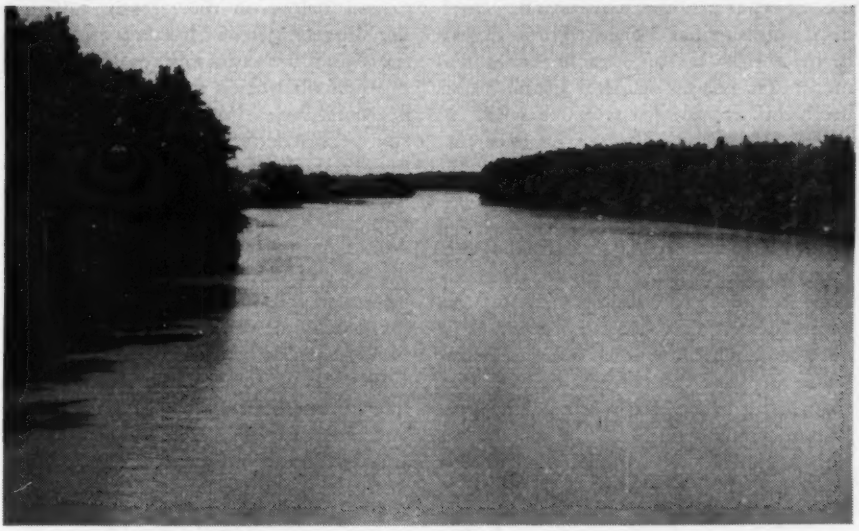

Fig. 1. The many rivers which flow across South Carolina provide an abundant supply of water for domestic purposes, transportation, power, industry, and recreation.

South Carolina's Approach to New Water Management

By C. P. Guess, Jr.

South Carolina Soil Conservation Committee, Columbia, South Carolina

IT seems to be historical fact that when water becomes short of need, a new approach to its development and use must be found. Such an approach requires a quantitative basis for apportionment in due regard to the wants and needs of all our people. The old systems do not seem to have been based upon a quantitative approach, and this has led to waste of an otherwise invaluable basic resource and its use only by a few who happen to have favored positions on the streams.

General L. G. Merritt, Director, Legislative Council of the South Carolina General Assembly, addressing the Water Management Conference of the South Carolina Soil Conservation Committee in July 1954 had this to say:

". . . It was not until 1901 in the case of White vs. Whitney Mfg. Co. that the court laid down the broad principles of the riparian doctrine in a dispute over the detention of water by an upper proprietor. The court quoted the view of Kent on the riparian doctrine, and his language was quoted in full in the decision.

"Here is what Kent said: 'Every proprietor of lands on the bank of a river has naturally an equal right to the use of the water which flows in the stream adjacent to his lands, as it was wont to run (*currere solebat*) without diminution or alteration. No proprietor has the right to use the water to the preju-

dice of other proprietors, above or below him, unless he has a prior right to divert it, or a title to some exclusive enjoyment. He has no property in the water itself, but a simple usufruct while it passes along. . . . Though he may use the water while it runs over his lands, he cannot unreasonably detain it or give it another direction, and he must return it to its ordinary channel when it leaves his estate. Without the consent of the adjoining proprietor, he cannot divert or diminish the quantity of water which would otherwise descend to the proprietor below, nor throw the water back upon the proprietor above, without a grant or an uninterrupted enjoyment for twenty years, which is evidence of it. This is the clear and settled general doctrine on the subject, and all the difficulty that arises consists in the application. The owner must so use and apply the water as to work no material injury or annoyance to his neighbor below, who has an equal right to the subsequent use of the same water. Streams of water are intended for the use and comfort of man; and it would be unreasonable and contrary to the universal sense of mankind to debar every riparian proprietor from the application of the water to domestic, agricultural and manufacturing purposes, provided the use of it be made under the limitations which have been mentioned, and there will, no doubt, evidently be, in the exercise of a perfect right to use the water, some evaporation and decrease of it, and some variations in the weight and velocity of the current; . . . a right by the proprietor below, would not necessarily flow from such consequences, but would depend upon the nature and extent of the complaint or injury, and the manner of using the water. All that the law requires of the party, by or over whose land a stream passes, is, that he should use the water in a reasonable manner, and so as not to destroy or render useless, or materially diminish or affect the application of the water by the proprietor below on the stream; he must not shut the gates of his dam and detain the water unreasonably, or let it off in unusual quantities, to the annoyance of his neighbor. Pothier lays down the rule very strictly, that the owner of the upper stream must not raise the water by dams, so as to make it fall with more abundance and rapidity than it would naturally do and injure the proprietor below. But this rule must not be construed literally, for that would be to deny all valuable use of the water to the riparian proprietors. It must be subjected to the qualifications which have been mentioned, otherwise rivers and streams of water would become utterly useless either for manufacture or agricultural purposes! . . .'"

Fifty-three years have passed since this opinion of the court was handed down. The court at this time recognized a strict interpretation of the riparian rule could become a burdensome restriction on the development and use of our natural waters.

However, the theory of the riparian rule does little to encourage development of storage facilities and adoption of conservation methods to store water from rains. It seems to imply that we must continue to live with floods and droughts. It seems to contribute to waste of water rather than beneficial use.

The Conflict

Our problems in South Carolina probably are more or less typical of those in many of the Eastern States and can be indicative of what is to be faced and what can be done about them.

On most South Carolina streams, as is to be expected in a humid region, one or more groups of water-users have made investments in equipment, plants, and facilities, feeling that there would always be sufficient water to meet their needs. Many landowners feel that they own the water in streams touching their land. There is the catch, for stream waters apparently are the property of the people of the state, subject to estab-

lished rights of use.

When on a given stream two users of water are in conflict as to its ownership, who shall say which user has the better claim? Apparently, only a court can decide. If a would-be user of water, before making financial investment in equipment and other resources, wants to know what portions of the water in a stream he can depend upon, to whom can he turn for assurance that an upstream user will not later claim the flow?

Farmers, cities, industrial plants, and recreational users find themselves in the same general state of confusion when these questions are posed. Apparently, only a jury can decide, unless the General Assembly grants specific rights to water for a specific purpose and at a specific place. This has occurred in the development of some hydro-electric power projects and municipal water supplies in South Carolina over the years. These methods of securing rights and in authorizing condemnation by cities to water are generally slow, costly, and insufficiently planned.

A Solution

In a related field, South Carolina in company with many other states, has asserted its responsibility to her citizens. In 1950 the South Carolina General Assembly created the Water Pollution and Control Authority. This unit of the health department seeks to prevent new pollution and correct old causes of lower water quality. It must approve any new plans for loading of streams beyond their capacity. Properly managed, a stream can neutralize some impurities. Overloaded, it loses this ability. Frequently, when stream quality is lowered beyond certain points, the water is rendered useless to lower proprietors.

The General Assembly of 1953, again fulfilling a responsibility to the citizens, ". . . declared to be the policy of the State of South Carolina that control of development and use of water for all beneficial purposes should be in the State, which, in the exercise of its police powers, should follow a course which will effectuate full utilization and protection of the water resources of the State. . ."

This act further created an eleven-member committee to conduct a study into the matter of implementation by the General Assembly of a water policy of the State, particularly as to natural stream and lake waters.

The membership of this Water Policy Committee included: Senators M. E. Abrams, chairman, R. M. Jefferies, Alfred Scarborough, and Members of the House of Representatives J. Reaves Coker, Donald V. Richardson, H. Talmadge Edwards. Appointees of the Governor were Seth A. Meek, Arthur M. Field, Henry Busbee, Joe B. Douthit, and C. P. Guess, Jr.

The report of the Water Policy Committee to the General Assembly in 1954 pointed to the necessity of careful study and review in designing legislation to meet the needs of the many water-users of the State. The report of the Committee pointed to the necessity of adopting a system of appropriation in order to encourage development and to protect investments dependent upon water supplies.

The law proposed by this Committee, among other things, pointed to two main accomplishments: 1. Orderly and legal development of water and land resources with greater security of investment in such development; 2. Better and more beneficial use of our abundant water supply.

With the authority granted under the proposed law, the Board of Water Commissioners could establish a priority of rights to the water in any stream or lake. A new user would know the maximum amount of water he could take under normal supply conditions. In the event of reduced stream flow, he would know in advance how many users have earlier claims to the available supply. He would be aware of his risk before making his investment.

(*Turn to page* 42)

Leaf Rust Reaction in Relation to Wheat Fertilization in Indiana

By K. D. Doak

Crown Point, Indiana

WHEAT leaf rust, *Puccinia rubigo-vera tritici*, has shown fluctuating annual intensities of infection at various localities in Indiana. Differences in the amount and type of infection on varieties of wheat occurred each year due to the unpredictable proportionate prevalence of each of the various physiologic forms of this rust and also the seasonal differences in time of infection.

In evaluation of the direct effects of rust and the nutritional factors affecting yield, distinction between the inherent susceptibility of certain varieties of wheat and the relative tolerance of infection has been difficult under field conditions. Furthermore, on certain years the heavy infections appeared so late that influence on yield could be considered insignificant. Since the influences of mineral excesses and deficiencies appeared specific under controlled conditions (3), four wheat varieties were grown at three locations under comparative fertilization to examine these relationships under field conditions.*

Rust Development and Fertilization

On a soil at Lafayette showing some deficiency in nitrogen and phosphorus, fertilizer applications resulted in less significant changes in the final amount of rust on some of the varieties used than at the other two locations in Indiana. Iobred wheat here showed a maximum range of 65-80 per cent rust and 70-80 per cent with a complete fertilizer. Such ranges in the amount of rust cover fluctuations in individual rows but not the sections of rows and individual plants. An application of nitrogen and phosphorus on this variety showed a significant rust increase or a range of 75-95 per cent. Phosphorus or potassium separately induced no marked change in amount of rust.

Purkoff wheat, on the other hand, showed an increase from 25-40 per cent unfertilized to 40-60 per cent with complete fertilizer. Phosphorus and nitrogen together produced nearly the same increase as the complete fertilizer. Phosphorus or potassium applied separately showed little effect.

The varieties Kanred and Kawvale, which showed varying degrees of resistant reaction on all field plots, showed generally less rust on the Lafayette plots than Iobred and Purkoff and the influences of each of the fertilizer applications were less significant. Rust increases on the Lafayette plots continued during a second year with some additional fertilizer combinations were confined mainly to the nitrogen increases.

Nitrogen alone applied to a markedly nitrogen-deficient soil at Vincennes, Indiana, caused a rust increase on Purkoff from 35-50 per cent unfertilized to 55-70 per cent. A double nitrogen resulted

* Excerpt from a dissertation, Purdue University, Department of Botany and Plant Pathology. The writer is indebted to Dr. E. B. Mains and Dr. G. N. Hoffer for valuable suggestions and to the American Potash Institute, Inc., for support throughout the investigation.

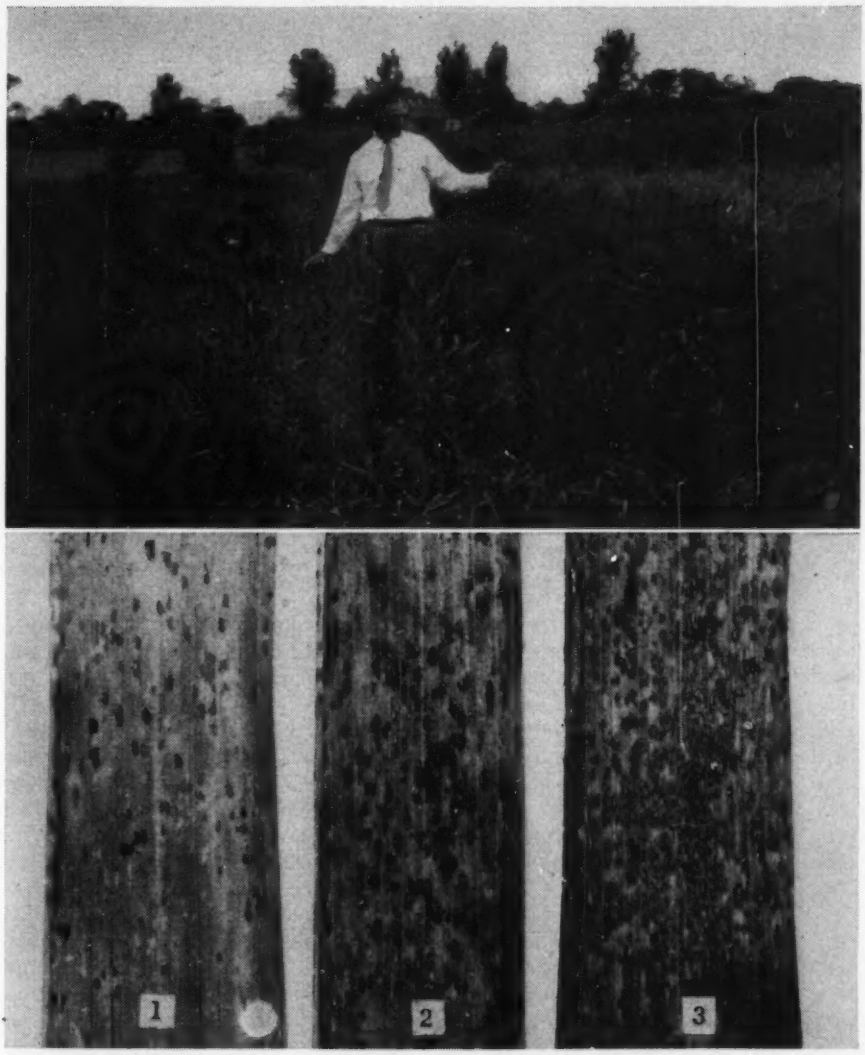

Fig. 1. Purkoff wheat at Vincennes, Indiana. Top left unfertilized; right nitrogen. Below: (1) Unfertilized, yield 10.2 bushels, rust 40-50 per cent; (2) Nitrogen, yield 28.4 bushels, rust 60-70 per cent; (3) Nitrogen doubled, yield 24.3 bushels, rust 75-85 per cent.

in further increase to 75-85 per cent while neither a complete fertilizer nor nitrogen and potassium showed more than the unfertilized. The resistant variety, Kanred, showed 35-45 per cent unfertilized, 45-60 per cent with nitrogen, and 55-65 per cent with double nitrogen. Kawvale and Iobred showed lesser increases with the single and double nitrogen applications and slightly less with the complete fertilizer than the unfertilized. Since the complete fertilizer produced no change in the rust on these four varieties at Vincennes, all significant increases were thus associated with nitrogen application alone.

Kanred wheat on a potassium-deficient soil near Rensselaer showed 25-40 per cent rust unfertilized, 40-50 per cent with a complete fertilizer, 35-50 per cent with nitrogen plus potassium, but failed

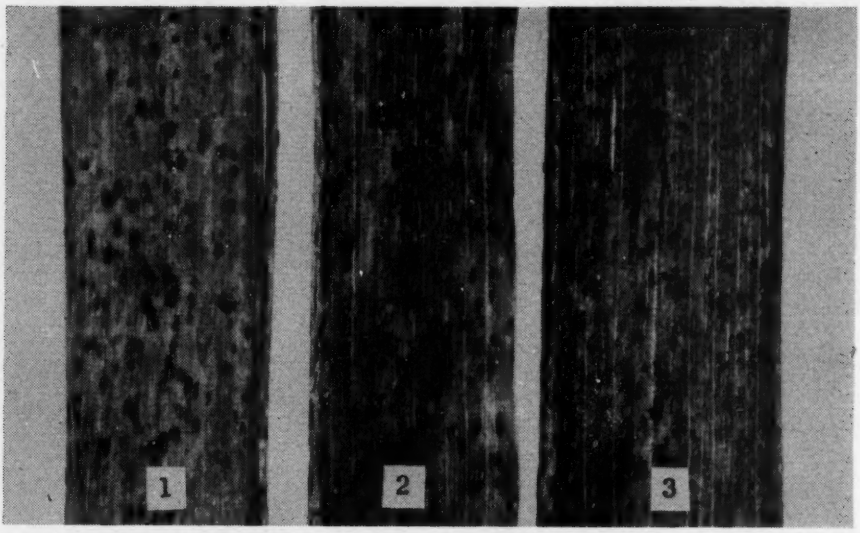

Fig. 2. Purkoff wheat at Rensselaer, Indiana. (1) Unfertilized, yield 20.7 bushels, rust 60-70 per cent; (2) Potassium, yield 25 bushels, rust 60-70 per cent; (3) Nitrogen and potassium, yield 31.1 bushels, rust 65-75 per cent.

to show any increase with potassium alone. Although a similar tendency was shown by Kawvale, the two more susceptible varieties, Iobred and Purkoff, were changed only slightly. Most of the rust development occurred late, and since the ripening time at Rensselaer was 20 days later than at Vincennes, the reaction was affected by low moisture and higher temperatures.

Yield Response to Fertilization

Average yields for Iobred wheat at Lafayette showed increases over the unfertilized check for phosphorus 5.7, nitrogen plus phosphorus 9.4, potassium 6.4, and the complete fertilizer 5.1 bushels per acre. This was not a general trend for all varieties since Purkoff showed greatest increase, 16.2 bushels, with the complete fertilizer and Kanred responded less to all excepting phosphorus alone. A second-year series of plots at Lafayette showed similar yield responses. Reduced stand due to winterkilling resulted in lower yields which were not comparable with the previous year's results.

At Vincennes more pronounced response to nitrogen occurred, but the unfertilized check yield was lower than the other locations. Purkoff showed yield increases for nitrogen 18.2, complete fertilizer 17.0, nitrogen plus potassium 15.3, and double nitrogen 14.1 bushels. Although Kawvale and Iobred showed the greatest increases with double nitrogen, responses with other fertilizer combinations were similar. All varieties showed general lodging with double nitrogen before maturity.

A higher yield on unfertilized plots at Rensselaer for all varieties accounted for the considerably lower average responses to the different applications. Iobred showed yield increases for phosphorus 6.7, potassium 7.0, nitrogen plus potassium 9.8, and complete fertilizer 18.1 bushels. The more rust-resistant Kanred and Kawvale showed less response to phosphorus, 4.2 and 3.4, and more response to potassium, 8.3 bushels each respectively. The Rensselaer plots were latest in maturity, harvested July 9, and, during the period of greatest increase in amount of rust beginning June 20, temperatures were higher and moisture supply limited.

Rust Tolerance and Yield Evaluation

When the ability of each wheat variety to withstand rust attack was taken

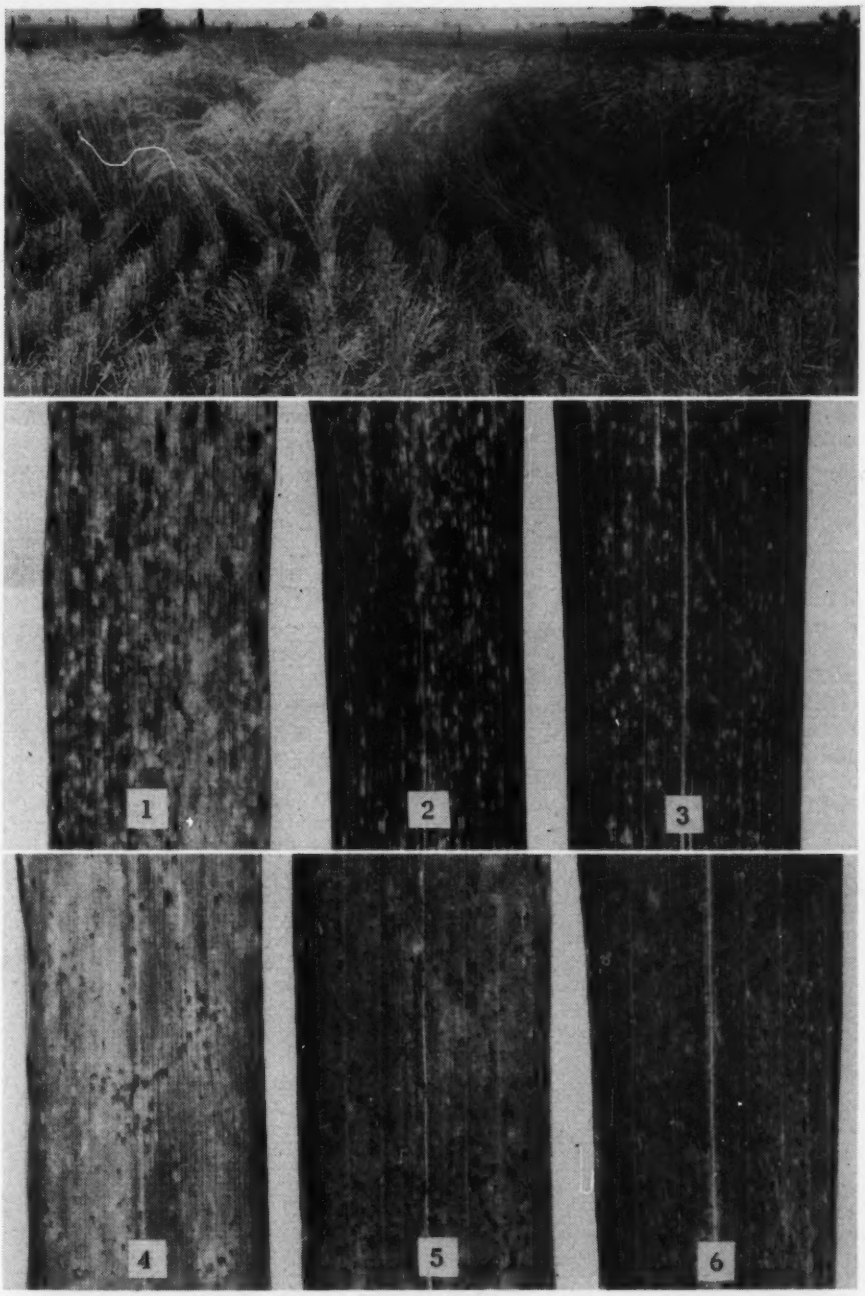

Fig. 3. Iobred wheat at Rensselaer, Indiana. Top, at harvest on July 9, left unfertilized, right nitrogen plus potassium. Below, showing variations in rust reaction: (1 and 4) Unfertilized, yield 18.3 bushels, rust 60-80 per cent; (2) Potassium, yield 25.3 bushels, rust 65-75 per cent showing necrosis due to wilting; (5) Same as 2, not wilted, showing pustule formation; (3) Complete fertilizer, yield 36.4 bushels, rust 65-75 per cent, showing necrosis due to wilting; (6) Same as 3, not wilted, showing pustule formation.

into account, there appeared a general tendency for larger amounts of rust associated with the higher yields. The responses of Iobred and Purkoff to nitrogen at Vincennes, Kawvale and Iobred to nitrogen plus phosphorus at Lafayette, and Kawvale to nitrogen plus potassium at Rensselaer showed this relationship. A camparison of all plots, and without eliminating the instances of very small yield responses, showed that such a generalization was inapplicable for most of the other results. Lack of a rust-free group of plots for comparison did not mean that an evaluation of rust tolerance was impossible. A uniform stand of wheat and relatively heavy natural infection with rust made smaller differences in the rust-yield balance comparable.

Kawvale at Rensselaer showed yield increases of 20.3 bushels with complete fertilizer and 8.3 bushels with potassium without a marked change in the amount of rust. Nitrogen applied with potassium, however, produced an increase in rust, but it was found that all varieties here showed about the same amount of rust with complete fertilizer as the check and yet showed highest yield. Despite 15 to 20 per cent increases in rust, Purkoff at Lafayette showed with nitrogen plus phosphorus and complete fertilizer yield increases of 12.9 and 16.2 bushels respectively. Other varieties showing similar rust increases responded less in yield especially with complete fertilizer. Even with a reduced stand due to winterkilling the following year, yield responses with an average lighter rust infection were similar.

Interacting Influences on Rust Reaction

Reaction symptoms under field conditions, disregarding the relative number of lesions, varied widely for each variety at the three Indiana locations. The apparent discoloration and often killing of tissues in the areas around individual infection points were influenced by fertilization (Figs. 1 to 4). Size of the uredinia and spore masses was likewise affected. On the nitrogen-deficient unfertilized plots at Vincennes, Iobred and Purkoff showed more general chlorosis or discoloration around infection points than on the nitrogen and double nitrogen plots. The more resistant Kanred showed both killing

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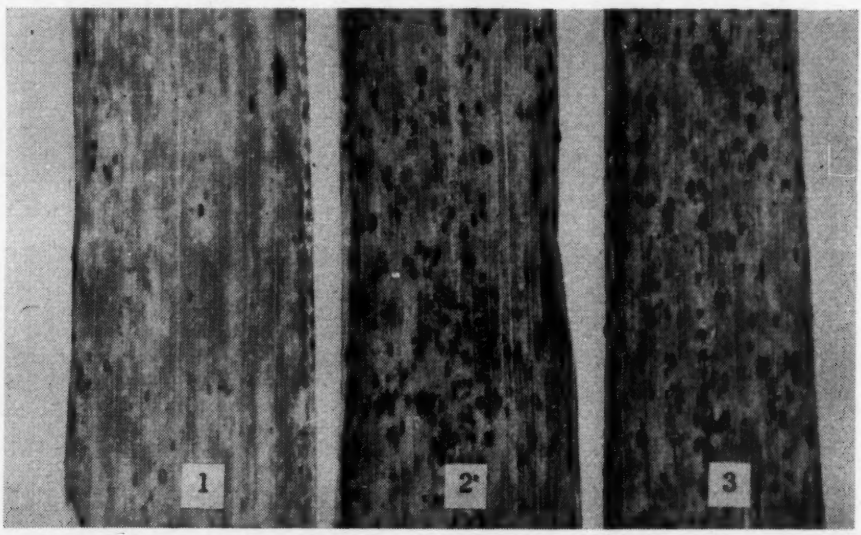


Fig. 4. Purkoff wheat at Lafayette, Indiana. (1) Unfertilized, yield 21.6 bushels, rust 35-45 per cent; (2) Nitrogen, phosphorus, and potassium, yield 37.8 bushels, rust 55-65 per cent; (3) Nitrogen and phosphorus, yield 34.5 bushels, rust 55-65 per cent.

Foliar Application of Plant Nutrients to Vegetable Crops

By Jackson B. Hester

Jackson B. Hester Agricultural Research Laboratories, Elkton, Maryland

AGROBIOLOGISTS have been slow to realize the importance of supplying nutrients to plants through the leaves or foliar parts of the plant. Anyone that has lived in the Southern States knows that Spanish or gray moss lives entirely on the nutrients that it picks up from the air. Also anyone who has been in the tropics readily understands that many plants live on the water and nutrients that are absorbed from the air. Those familiar with the growth of cactus and aloe in Aruba and other tropical areas realize that much of the nutrients involved in the metabolism of the plant is absorbed through the plant from the air. Even in the northern sections lichens obtain almost all the nutrients that sustain their growth from floating dust. Therefore, it is believed that the question of the use of nutrients to feed plants through the leaves has been a neglected phase of agricultural science.

Potassium can be readily washed out of the leaves of plants. Therefore, in the right proportion or combination, potassium and other nutrients can be applied to the leaves with the reverse action. Much of the biological activity of soils and plants is associated with cationic and anionic exchange complexes. This exchange can take place through the foliar membrane as well as through the root cell structure. In fact, there is very little difference in the cell structure of roots and foliage. The principal difference in the two complexes is that there is capillary action and evaporation of water from the foliar cells. So, this question of absorption of nutrients through the leaves and utilization of plant nutrients through leaf fertilization is important.

This past year at Galena, Maryland, because of an extremely dry soil condition, tomatoes were observed to be deficient in nitrate nitrogen whereas the soil was rather high in nitrate nitrogen. It was also observed earlier at Bridgeton, New Jersey, that tomato plants actually extruded water from the root system in order to produce conditions favorable for absorption of plant nutrients from the soil. In other words, the nutrients were not available in the lower strata of soil but were available in the upper strata, and so the plant brought the water from below and utilized the plant nutrients in the upper strata of the soil. This seems to be an almost paradoxical statement. However, it is not and this can also be verified by the fact that tree and plant roots will not penetrate soil where there is insufficient oxygen to support normal cell development.

Variability of Tolerance of Plants

Attention has been called to the fact that plants vary extremely in their ability to absorb plant nutrients. Crops like tomatoes that have succulent growth are less adapted to the use of

foliar sprays than carrots, asparagus, and similar crops that have less succulent growth.

It has been found that tomatoes will tolerate only between four and five pounds of urea per 100 gallons of water used as a spray material at the rate of 150 gallons per acre. The recommended spray program consists of five to seven sprays of insecticides and fungicides per crop. This spray material is likewise applied at the rate of 150 gallons per acre. It, therefore, becomes obvious that a moderate amount of nitrogen can be applied as urea spray at the time of the regular spray program. It has been the experience of the author that urea is compatible with the fungicides and insecticides ordinarily applied.

Ten sprays of urea at weekly intervals, with 1,500 pounds of an 0-10-10 fertilizer mixture as compared with 1,500 pounds of a 5-10-10 produced a comparable yield. This work has been conducted several years. Better results were obtained with a 3-12-12 fertilizer mixture and the nitrogen as a spray supplement. When urea was mixed with ammonium nitrate, twice as much nitrogen could be applied. When the properly balanced complete fertilizer mixtures are established for foliar application, undoubtedly greater concentrations can be used for a respective crop.

The situation is considerably different in carrot production. As much as 30 pounds of urea per 100 gallons of water have been used on carrots, but the suggested rate is 20 pounds in 100 gallons. A considerable portion of the nitrogen used by carrots can be applied in the three or four spray program applied to control diseases and insects.

Original work with carrots was designed to supply all of the nitrogen from urea spray, in which case a ton of 0-10-10 fertilizer was applied broadcast previous to planting. It became evident that it was more desirable to apply part of the nitrogen as commercial fertilizer using a 3-10-10 or 3-12-12 fertilizer and supplementing with urea spray.

No incompatibility of the urea spray with the insecticides and fungicides normally used for tomatoes and carrots has been observed.

Complete Sprays

Information now available indicates that many plants have a high nitrogen and potassium utilization and a comparatively low utilization of phosphorus. Thus a foliar application should correspond with the chemical composition of the plants more so than fertilizer applied to soil. Broccoli with a 20-ton-per-acre yield would utilize 160 pounds of nitrogen, 41 pounds of P_2O_5, and 84 pounds of potash (K_2O), and foliar feeding should be on a similar ratio. Peanuts have a relatively high calcium and phosphorus requirement and should have a foliar spray relatively high in these elements, low in nitrogen, and moderate in potash.

Under certain conditions there is a competition between the soil and the plants for certain plant nutrients, particularly phosphates. Tomato plants grown without fertilizer in the row on a Tifton sandy loam with an acid soil reaction and a depleted phosphorus and potash condition were sprayed with complete mixtures as well as urea alone. The plants absorbed the plant nutrients but sacrificed them to the soil.

The soil must be supplied with phosphatic materials in order for the plant to be able to utilize the nitrogen and potash in the form of spray material. Perhaps much of the literature on the subject of the ready absorption of the nutrients, particularly phosphate, is based on sand culture work where there is no competition between the plant and soil.

This article in no way attempts to point out the value of minor element sprays supplying elements such as zinc, copper, manganese, magnesium, boron, and others.

In conclusion it can be safely stated that foliar sprays can be effectively utilized as a supplemental method of fertilization.

LAND! WATER! PEOPLE!

By T. S. Buie

Soil Conservation Service, Columbia, South Carolina

LAND, Water, People—each stands in intimate relationship to the other two, for land and water are inseparable in agriculture and it is only as people wisely use their land and water resources that they are properly nourished and sustained in health. The dependence of people upon the land is well known, but often we overlook a similar dependence upon water. We can live much longer without food than without water, and soil alone—important though it is—cannot produce crops.

The early settlers of our country located their homes near springs or running streams. Wells supplanted these natural sources of supply as new and larger settlements were made. Later, as the population increased still more, it became necessary to look to the larger streams. Today, much of the water used by our people comes from rivers and lakes, purified before being used, of course, because pollution always results where a great many people live close together.

We might well say that our civilization is dependent upon an abundant supply of water. Just as the early settlers built their homes where there was plenty of good water readily available, so are our modern urban areas developed in the proximity of a bountiful supply. This is especially true of manufacturing activities which require large quantities of water.

To the boy who had to carry water from a spring, always uphill, or draw it from a well at the edge of the yard, it seemed that the buckets were always empty. But the amount which sufficed for the daily needs of a family in the time of our grandparents would last but a few minutes in the modern home.

Much water is used in personal cleanliness and to operate such modern household gadgets as washing machines, automatic dishwashers, and garbage disposal units. The faucet is turned on with never a thought as to the source of supply or that it may ever give out. It is not until a severe drought or similar catastrophe necessitates stringent limitations on the use of water that we realize our dependence upon a remote supply. And then we complain loudly and bitterly!

Just as we use more water in our homes than did our grandmothers, so do we use more in our farming operations than did our grandfathers. To

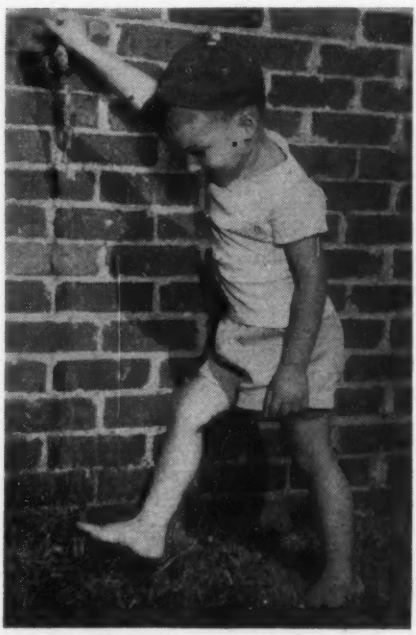


Fig. 1. Will we always be able to turn the tap with the confidence of this carefree lad?

mix spray materials, to clean dairy barns, and to carry out many other operations on the modern farm require a lot of water. And then our many animals consume tremendous quantities. It is said that a cow drinks from 15 to 25 gallons each day. No man who as a boy carried bucketful after bucketful to cows in a dry lot will question the amount, unless to say it is too low.

Vast as are the increases in the amount of water used for domestic purposes, it is in irrigation that its agricultural use is really increasing at a rapid rate. Three years of drought have resulted in greatly increased demands for irrigation equipment throughout a large part of the country and for technical assistance in designing and installing such systems and for developing dependable supplies of water.

It would seem that in a section where the average rainfall may be as much as 50 inches per year, reasonably well distributed throughout the seasons, there would be little or no need for supplemental irrigation. Not so, for even in years of normal rainfall there are almost always short periods when crops suffer from the effects of drought.

Farmers are finding that if they are to reap maximum benefits from modern research they must be prepared to add water as needed by the growing crop. Increased amounts of fertilizer, for instance, are ineffective if there is insufficient moisture in the soil. On the other hand, where there is plenty of water available to the growing plants, farmers are finding that increased amounts of fertilizer pay well.

The same situation prevails as to other modern agricultural developments. The more productive varieties of crops and disease and insect control measures are not fully effective if soil moisture is a limiting factor in plant growth.

Notwithstanding the greatly increased consumption of water in the household and on the farm, it is in our modern manufacturing plants that really prodigious quantities are required. To manufacture one ton of steel requires 65,000 gallons of water and for a ton of wood pulp about as much. Twenty-five pounds of paper—which quantity doubtless is carried into most modern homes each week—requires, therefore, nearly 1,000 gallons of water or about 30 barrels. And then we wonder why we do not always have plenty of water, even in times of severe drought.

In addition to their utilitarian uses, more and more people are looking to streams, lakes, ponds, and other bodies of water for recreation. While such use may not justify as high priority as do those which contribute directly to the production of food or fiber, it deserves careful consideration. Fishing, swimming, boating, and similar recreational activities contribute to the welfare of people, and the needs of participants in such sports should be given attention in the development of the water resources of an area.

With an ever-increasing demand to meet the needs of our complex civilization, it is inevitable that domestic, agricultural, municipal, industrial, and recreational uses of water will, from time to time, be in conflict. It is high time, therefore, that we give attention to our increasing needs for water and the relationship in which these separate needs stand toward one another.

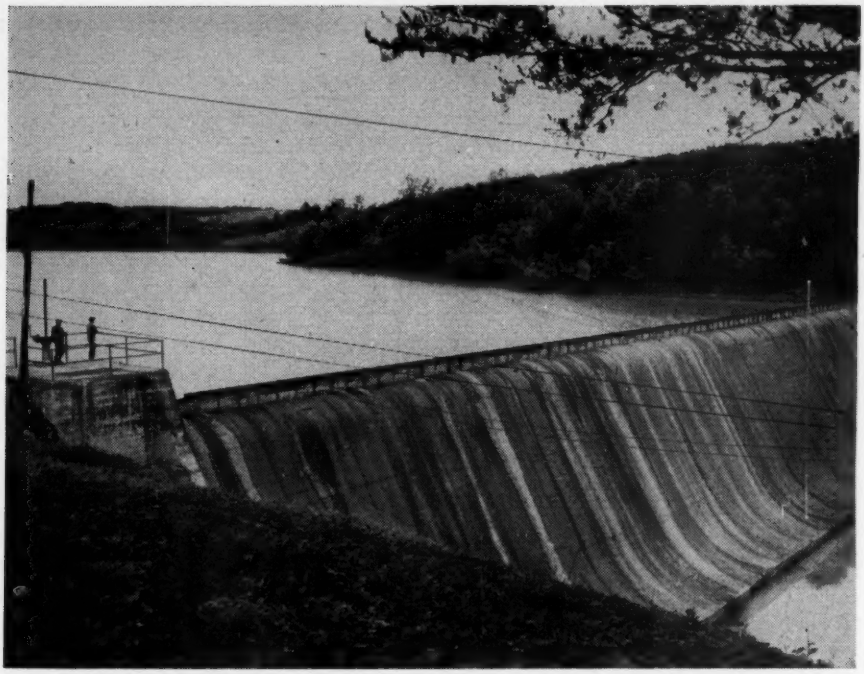
The work of various federal and state agricultural agencies bears testimony to the increasing interest on the part of farmers everywhere in their water requirements. In a recent discussion of current research needs by a group composed of research scientists, soil conservation technicians, and soil conservation district supervisors, more emphasis was placed on water and its manifold relationships to agriculture than on any other subject. This interest is but a reflection of farmer interest.

The irrigation experiments being conducted by the South Carolina Experi-

(*Turn to page* 48)

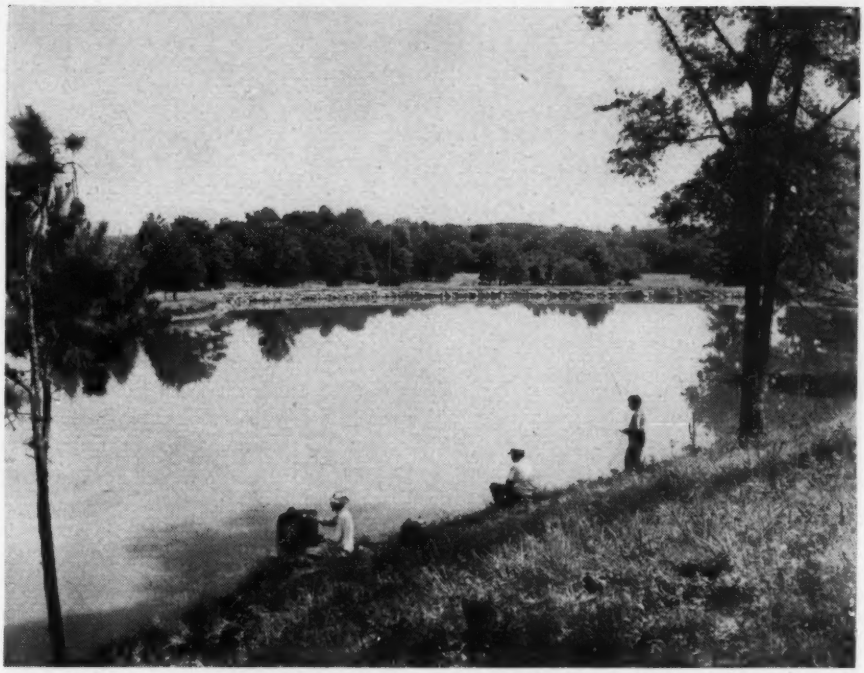
Above: The uncontrolled water of rivers in flood stage causes enormous losses of crops and other property.

Below: Drainage ditches, properly constructed, are required where there is too much water on the land.



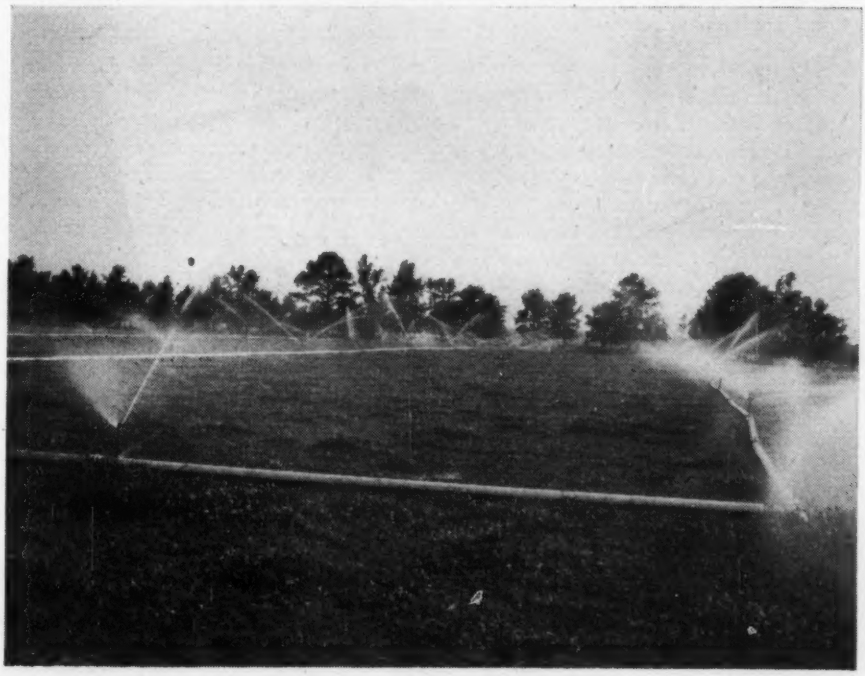
Above: Well-planned treatment for watersheds provides high quality water for city reservoirs.

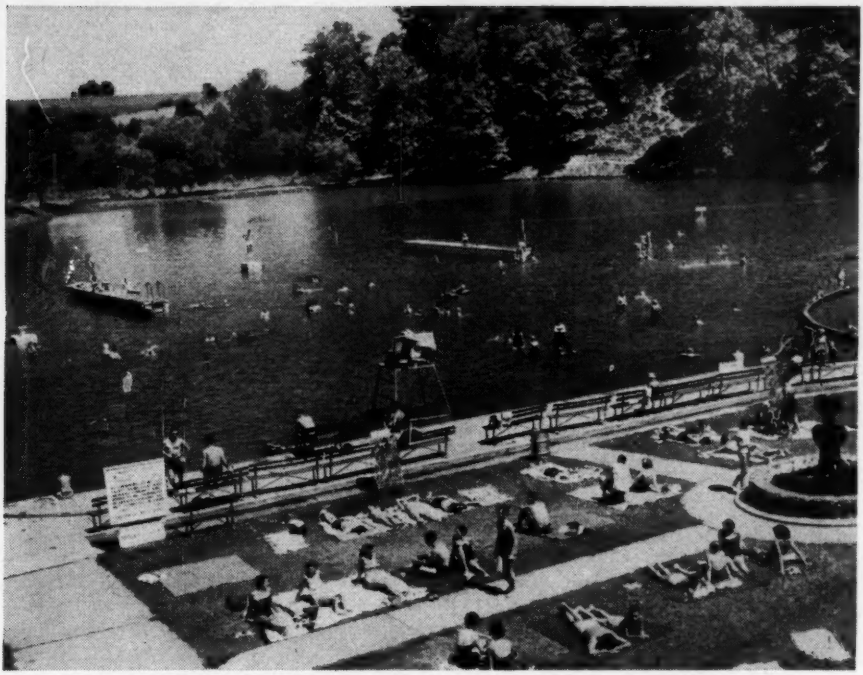
Below: Hydroelectric power for manufacturing plants is created by harnessing streams.



Above: Water stopped temporarily on its way to the sea that it may longer serve the landowners.

Below: Proper management of our water resources assures an abundant supply in times of drought.





Above: Well-planned recreational facilities contribute to the happiness of people.

Below: Modern living requires more and more water, when and where we want it.

The Editors Talk

Our Cover Picture

The pear is native of Europe, Asia, and nothern Africa. It was used as a food long before the Christian Era and was brought to this continent by the early settlers. In the United States, the greatest development in production has been on the West Coast, where most of the varieties now being grown can be made to reach a high state of perfection.

Pear trees have been a part of the California landscape for many years and were planted in the 18th century by the founders of the old Spanish missions along El Camino Real The adaptability of this fruit to the valley and foothill lands of the far West has been proven by the fact that important pear-producing areas are now in existence in California, Oregon, and Washington. This fruit has found favor as a fresh market item, and large tonnages from the Pacific Coast States enter the canned fruit market as well. A smaller tonnage is preserved as dried pears, spiced pears, and candied pears. California is the largest producer of pears and the annual crop in this State for the last five years has averaged about 350,000 tons and comprises about 43 per cent of the United States pear production. The value of this crop to the growers in the State last year was over $21,000,000.

Although there are a number of pear varieties grown commercially in the Western States, the most important one for both canning and fresh shipment is the Bartlett pear. Other varieties grown commercially in appreciable quantities are Anjou, Comice, Hardy, Bosc, and Nellis. The pear is considered to be a hardy fruit and will withstand such adverse conditions as poorly-drained, heavy soils and wide extremes of heat and cold. It is not unusual to see growing on old farmsteads pear trees which are estimated to be 75 to 100 years old.

Nitrogen fertilizers have been quite generally recommended in pear orchards along with good soil management practice. In some areas a need for micro-nutrients such as iron and boron has been recognized.

Within the past five years, potassium deficiency in pear orchards has been identified in several localities. The cover picture shows normal Bartlett pear spur leaves in the upper left and potassium deficiency symptoms on this type of leaf in the upper right. Upward rolling and marginal scorch are characteristic. Affected leaves are smaller and pale green in color. Such leaves usually have only 0.2 per cent to 0.4 per cent potassium when analyzed on a dry basis. Normal appearing pear leaves will have 0.75 per cent potassium or higher.

Small sized fruit is a result of the lack of sufficient potassium. The pear fruits at the lower right are typical of the unmarketable crop from potash-deficient trees. Applications of 25 pounds sulfate of potash per tree to adjacent trees in the same orchard resulted not only in tree improvement, but also in fruit of proper size to make No. 1 grade, such as the fruit at lower left of cover.

Planning Spring Fertilization

Used to be that little thought was given spring fertilization until the approach of the planting season. Not so now, when profit in farming depends upon efficiency at every turn. Wide-awake operators already are taking steps to save time, labor, and cut costs when the spring rush begins.

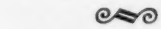
At least three important steps should be considered at this time: 1—Reviewing this year's practices in relation to results obtained; 2—collecting soil samples for testing; 3—ordering and taking delivery of the fertilizer to be used next spring.

There is more to the consideration of this year's results than just the recording of yields, costs, gross returns, and profit margins. Was the application of plant food adequate to carry the crop through to maturity? Did it produce the yields and quality desired? Was it balanced to meet the requirements of the crop in line with previous fertilization? What residues can be counted upon in figuring the new fertilization program? How did the application stack up with the official recommendations or with the newest research and experimental findings? What effect did the application have in carrying the crop through spells of unfavorable weather? All of these are factors to be studied in connection with new planning.

Soil samples for testing can be taken any time of the year. However, October, November, and December are the months in which they should be collected when the fertilizer is to be applied from March through May. This forehandedness helps insure the receipt of recommendations based on the chemical tests in time for the ordering of the right amounts of the right fertilizers. Despite the inconvenience of delays occasioned by the rush at testing laboratories in the spring, the largest number of samples are still taken during the early spring. Much emphasis has been put upon the care which should be exercised in the taking of soil samples. Unless they are representative of conditions found in the fields, the most accurate chemical tests will be practically worthless. Fall, without its rush of work, is more conducive to the collecting of representative samples.

When possible improvements over this year's methods have been determined, and the results and recommendations from the soil tests have been received, there should be no delay in ordering and taking delivery of the fertilizer. In many instances it can be applied ahead of the spring rush of work. In any event, early delivery will insure its being available when wanted. Another advantage of early ordering is the greater assurance of getting exactly what is wanted. Suppliers caught in the spring rush of deliveries cannot always produce without delay the requested analyses.

Other phases of spring fertilization undoubtedly will be suggested to the operator planning ahead. Preceding the advent of the almanacs and seed catalogs, they will relieve the boredom of winter days. Acted upon, as in the three instances cited, they will add to the efficiency of the grower in stretching his profit margin. Let's have more planning of spring fertilization now.



"A farmer has to be economist enough to know when to buy and when to sell, and bookkeeper enough to know where he's making and where he's losing money. He has to be engineer enough to run $10,000 worth of farm machinery, and mechanic enough to fix it when it breaks down.

"He's a gambler on weather and prices. He's a veterinarian and he looks for disease. He's a diplomat, weatherman, agronomist, and entomologist.

"He has to be a jack of all trades—and master of all." *Secretary of Agriculture, Ezra Taft Benson.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	36.9	50.0	196.0	331.0	157.0	209.0	21.05	70.00	....
1953									
November...	31.82	42.3	83.4	232.0	133.0	200.0	17.25	53.40	....
December....	30.73	49.2	69.9	246.0	141.0	201.0	18.25	53.00	....
1954									
January.....	30.05	48.3	69.1	253.0	142.0	203.0	19.05	52.00	....
February.....	30.42	31.9	65.3	258 0	143.0	206.0	18.95	51.40	....
March.....	31.05	27.3	53.2	252.0	144.0	209.0	18.35	50.50	....
April.....	31.57	....	70.2	268.0	145.0	206.0	18.05	50.80	....
May.....	32.17	58.0	134.0	263.0	147.0	200.0	17.05	51.40	....
June.....	32.31	53.0	151.0	270.0	149.0	191.0	15.65	51.40	....
July.....	32.18	52.7	149.0	302 0	150.0	200.0	15.15	54.00	....
August.....	34.00	48.2	141.0	259.0	153.0	203.0	16.45	61.30	....
September...	34.55	53.0	116.0	236.0	153.0	207.0	17.25	61.60	....
October.....	34.67	53.6	93.2	212.0	145.0	208.0	17.55	60.20	....
	Index Numbers (Aug. 1909—July 1914 = 100)								
1928.....	145	200	76	134	131	113	95	152	147
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	63	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	298	500	281	377	245	236	177	310	274
1953									
November...	257	423	120	264	207	226	145	237	186
December....	248	492	100	280	220	227	154	235	224
1954									
January.....	242	483	99	288	221	230	160	231	271
February....	245	319	94	294	223	233	160	228	233
March.....	250	273	76	287	224	236	155	224	246
April.....	255	...	101	305	226	233	152	225	225
May.....	259	580	192	300	229	226	144	228	279
June.....	261	530	217	308	232	216	132	228	200
July.....	260	527	214	344	234	226	128	239	243
August.....	274	482	202	295	238	230	139	272	223
September...	279	530	166	269	238	234	145	273	170
October.....	280	536	134	241	226	235	148	267	191

Wholesale Prices of Phosphates and Potash **

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953							
November	.895	....	....	.396	.768	14.72	.193
December	.895	....	....	.430	.827	16.00	.210
1954							
January	.895	....	....	.430	.827	16.00	.210
February	.895	....	....	.430	.827	16.00	.210
March	.895	....	....	.430	.827	16.00	.210
April	.895	....	....	.430	.827	16.00	.210
May	.895	....	....	.430	.827	16.00	.210
June	.895	....	....	.359	.710	13.45	.174
July	.895	....	....	.388	.765	14.75	.184
August	.895	....	....	.388	.765	14.75	.184
September	.895	....	....	.388	.765	14.75	.184
October	.895	....	....	.388	.765	14.75	.184
Index Numbers (1910-14 = 100)							
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953							
November	167	...	...	71	81	61	82
December	167	...	...	76	87	66	85
1954							
January	167	...	...	76	87	66	85
February	167	...	...	76	87	66	85
March	167	...	...	76	87	66	85
April	167	...	...	76	87	66	85
May	167	...	...	76	87	66	85
June	167	...	...	66	75	56	79
July	167	...	...	70	80	61	81
August	167	...	...	70	80	61	81
September	167	...	...	70	80	61	81
October	167	...	...	70	80	61	81

Wholesale Prices of Ammoniates**

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953						
November	3.09	2.22	9.61	11.24	8.19	8.19
December	3.09	2.22	10.96	11.24	8.50	9.03
1954						
January	3.09	2.22	11.28	11.24	9.26	9.71
February	3.09	2.22	11.20	11.45	9.34	10.02
March	3.09	2.22	11.35	11.70	9.59	10.20
April	3.09	2.22	11.63	12.15	10.32	10.55
May	3.09	2.22	11.40	12.15	11.47	10.74
June	3.09	2.18	10.76	12.15	10.09	9.87
July	3.09	2.18	11.12	11.28	10.02	9.87
August	3.09	2.18	12.37	11.19	9.83	11.19
September	3.09	2.18	11.51	10.85	9.78	10.09
October	3.01	2.18	11.55	11.26	9.64	9.94
	Index Numbers (1910-14 = 100)					
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953						
November	115	78	275	318	243	233
December	115	78	313	318	252	257
1954						
January	115	78	322	318	275	276
February	115	78	320	324	277	285
March	115	78	324	331	285	290
April	115	78	332	344	306	300
May	115	78	326	344	340	305
June	115	76	307	344	299	280
July	115	76	318	320	297	280
August	115	76	353	317	292	317
September	115	76	329	307	290	287
October	112	76	330	319	286	282

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1928.....	148	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	102	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953								
November.	249	259	247	137	96	267	167	75
December..	254	260	248	141	96	285	167	80
1954								
January...	259	263	250	142	96	300	167	80
February..	258	264	248	142	96	301	167	80
March....	256	264	250	143	96	307	167	80
April.....	257	265	250	145	96	323	167	80
May.....	258	267	250	147	96	338	167	80
June.....	248	265	248	141	95	311	167	69
July.....	247	263	248	142	95	310	167	74
August....	251	264	248	143	95	319	167	74
September.	246	263	248	142	95	308	167	74
October...	242	262	248	141	94	308	167	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

[2] **Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.**

** **Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Arkansas Fertilizer Recommendations," Agr. Ext. Serv., Univ. of Ark., Fayetteville, Ark., Cir. 467, Jan. 1954, W. R. Perkins, W. H. Freyaldenhoven, E. J. Allen, and R. Deere.

"Fertilizing Materials 1953," State Dept. of Agr., Sacramento, California, Spec. Bul. 251, April 1954.

"Fertilizer Experiments with Sugar Cane," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. 54, March 1954, E. S. Lyons.

"Fertilizer Recommendations for Louisiana, 1954-55," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Official Report, Maryland Inspection and Regulatory Service, Feed, Fertilizer and Lime Issue," Inspection and Regulatory Service, College Park, Md., Issue No. 231, Aug. 1954.

"Order in Yields from Fertilizer and Spacing in Corn Production," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 516, April 1954, O. T. Osgood.

"Urea and Calcium Cyanamide in Tobacco Plant Beds," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Tech. Bul. 105, May 1954, C. B. McCants and W. G. Woltz.

"Fertilize Corn for Higher Yields," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Bul. 366, March 1954, B. A. Krantz and W. V. Chandler.

"Fertilizing Burley Tobacco for High Quality and Yield," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 379, April 1954, R. R. Bennett, H. H. Nau, and S. N. Hawks, Jr.

"Calculation of Pounds of Fertilizer per Acre for Different Concentrations," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-35, Aug. 1954, J. E. Garton.

"Calculation of Comparative Cost per Unit of Nutrient Element from Different Fertilizers," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-36, Aug. 1954, J. E. Garton.

"Calculation of Amount of Fertilizer per Row for Gardens," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-37, Aug. 1954, J. E. Garton.

"Calculation of Amount of Fertilizer for Lawns," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-38, Aug. 1954, J. E. Garton.

"Calculation of Amount of Nitrogen Fertilizers for Trees," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-39, Aug. 1954, J. E. Garton.

"Calibration Chart for 10-foot Fertilizer Spreader," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-40, Aug. 1954, J. E. Garton.

"Calculation of Fertilizer Applications by Sprinkler Irrigation," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Misc. Pub. MP-41, Aug. 1954, J. E. Garton.

"Distribution of Fertilizer in Oklahoma Counties by Grades and Material for the Period July 1, 1953 to July 1, 1954," State Dept. of Agr., Okla. City, Okla., Annual Report.

"Recommendations for Seed, Fertilizer and Lime," Agr. Ext. Serv., Univ. of R. I., Kingston, R. I., Bul. 142, Rev. 1954, J. E. Sheehan.

"The Fertilizer Situation for 1954-1955," USDA, Commodity Stabilization Service, Wash., D. C., Sept. 1954.

Soils

"Tillage Practices for Irrigated Soils," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 257, June 1954, K. Harris, D. C. Aepli, and W. D. Pew.

"Effect of Soil Management Practices Upon Growth and Fruitfulness of Peach Trees," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. 300, Feb. 1954, C. W. Fitz.

"Soil Treatment Recommendations Based on Soil Tests," Agr. Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 724, June 1954, C. M. Linsley.

"The Effects of Deep Breaking on Mississippi Soils," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sh. 492, Jan. 1954, W. A. Raney, P. H. Grissom, E. B. Williamson, O. B. Wooten, and T. N. Jones.

"Irrigation and other Cultural Studies with Sweet Corn," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sh. 494, Jan. 1954, B. C. Murphy.

"Some Effects of Various Silicates, Lime, and Gypsum on Growth of Tomato Plants in Western and Eastern Soils at Low Levels of Phosphorus Nutrition," Agr. Exp. Sta., Cor-

nell Univ., Ithaca, N. Y., Memoir 326, Nov. 1953, G. J. Raleigh.

"Potassium Release from Exchangeable and Nonexchangeable Forms in Ohio Soils," Agr. Exp. Sta., Wooster, Ohio, Res. Bul. 747, Aug. 1954, P. F. Pratt and H. H. Morse.

"1955 National Agricultural Conservation Program Bulletin," USDA, Wash., D. C., July 1954.

"Soil Survey, Wise County, Virginia," USDA, Wash., D. C., Series 1940, No. 12, May 1954.

"Soil Survey, Crawford County, Pennsylvania," USDA, Wash., D. C., Series 1939, No. 18, April 1954.

"Soil Survey, Le Sueur County, Minnesota," USDA, Wash., D. C., Series 1944, No. 3, April 1954.

Crops

"Eastern Arkansas Small Grain Variety Trials, 1951-1953," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mimeo.Series 23, May 1954, R. L. Thurman, H. R. Rosen, W. J. Wiser, and J. O. York.

"Arkansas Coastal Plain Oat Variety Trials, 1951-1953," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mimeo. Series 24, May 1954, R. L. Thurman, H. R. Rosen, W. J. Wiser, and J. O. York.

"Arkansas Upland Small Grain Variety Trials, 1951-1953," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mimeo. Series 25, May 1954, R. L. Thurman, H. R. Rosen, W. J. Wiser, and J. O. York.

"Citrus Growing in Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 258, June 1954, R. H. Hilgeman and C. W. Van Horn.

"What's Ahead for Arkansas Agriculture," Agr. Ext. Serv., Univ. of Ark., Fayetteville, Ark., 1954.

"Onas 53 Wheat," Agr. Exp. Sta., Univ. of Calif., Davis, Calif., Bul. 742, C. A. Suneson and C. W. Schaller.

"Vegetable Varieties for Georgia Growers," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 581, Feb. 1954, B. B. Brantley, J. E. Bailey, O. J. Woodard, and R. Sheldrake.

"Landscaping Georgia Homes," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 583, April 1954, T. G. Williams.

"Planting Black Locust for Fence Posts," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Cir. 170, Dec. 1953, J. R. Hamilton.

"Romack Pea," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Lflt. 1, Sept. 1954, R. E. Burns,

"Idaho Recommends Crop Varieties to Fit Your Growing Conditions," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 209, April 1954.

"Growing Raspberries in Iowa," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Pamph. 214, April 1954, A. E. Cott, E. L. Denisen, and H. L. Lantz.

"Annual Progress Report, West Louisiana Experiment Station, DeRidder, Louisiana, 1953," Agr. Exp. Sta., DeRidder, La.

"1953 Annual Progress Report," North La. Exp. Sta., Calhoun, La.

"Planting Ornamental Trees and Shrubs," Agr. Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 80, March 1954, L. J. Enright.

"African Violets," Agr. Ext. Serv., Univ. of Mass., Amherst, Mass., Lflt. 263, March 1954, N. W. Butterfield.

"Recommended Vegetable Varieties for Michigan," Agr. Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Fldr. F-179, March 1954.

"Band Seeding for Better Forage Seeding," Agr. Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Fldr. F-180, March 1954.

"The First Forty Years at the Northeast Agricultural Experiment Station 1913-1953," Agr. Exp. Sta., Univ. of Minn., St. Paul, Minn., June 1954, M. J. Thompson.

"4-H Pastures," Agr. Ext. Serv., Miss. State College, State College, Miss., Pub. 232, April 1954, W. R. Thompson.

"Fescue," Agr. Ext. Serv., Miss. State College, State College, Miss., Pub. 267, June 1953, W. R. Thompson.

"Study of Composition of Missouri Grown Roughages," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 533, Oct. 1953, W. H. Cloninger and H. A. Herman.

"Physiology of Growth, Sugar Accumulation and Mineral Intake of Sugar Beets in Montana," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Tech. Bul. 491, Nov. 1953, M. M. Afanasiev, E. E. Frahm, H. E. Morris, and W. B. Johnston.

"Barley in Nebraska," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 423, Jan. 1954, O. J. Webster.

"Nebraska Varietal Tests of Fall-Sown Small Grains 1954, Winter Wheat-Winter Barley-Rye," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 37, Aug. 1954, A. F. Dreier, V. A. Johnson, and P. L. Ehlers.

"Nevada Results on Spring Barley and Wheat Variety Trials," Agr. Exp. Sta., Univ. of Nev., Reno, Nev., Cir. 5, April 1954, J. H. Robertson and E. H. Jensen.

"Growing Grapes in New Hampshire," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Cir. 309, Feb. 1954, L. P. Latimer.

"Cane Fruit Culture," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Cir. 310, March 1954, L. P. Latimer.

"Forest Tree Planting," Agr. Ext. Serv., Univ. of N. H., Durham, N. H,. Ext. Fldr. 27, March 1954.

"The Seventy-fourth Annual Report, 1952-1953," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J.

"A Variety of Hardy Bulbs for the Spring Flower Garden," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 559, June 1954, H. M. Biekart.

"Grass Silage Grassland Farming Series No.

1," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 561, May 1954.

"64th Annual Report of the New Mexico Agricultural Experiment Station for the Fiscal Year Ended June 30, 1953," Agr. Exp. Sta., New Mexico A. & M. College, State College, New Mexico.

"Factors Affecting the Germination of Sweet Corn in Low-temperature Laboratory Tests," Agr. Exp. Sta., Cornell Univ., Geneva, N. Y., Bul. 769, May 1954, B. E. Clark.

"Pennsylvania Corn Performance Studies, Double Cross Tests 1953," Agr. Exp. Sta., Penna. State University, State College, Pa., Prog. Rpt. 119, May 1954, L. L. Huber.

"Penngift Crown Vetch for Slope Control on Pennsylvania Highways," Agr. Exp. Sta., State College, Pa., Bul. 576, May 1954, H. B. Musser, W. L. Hottenstein, and J. P. Stanford.

"South Carolina Pastures," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Bul. 115, April 1954, H. A. Woodle and E. C. Turner.

"The 1953 Cotton Contest, South Carolina," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 391, Jan. 1954, S. A. Williams.

"Your home . . . Orchard," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Pub. 353, Feb. 1954, W. C. Pelton.

"Variety Performance Trials of Cotton, Corn, Barley, Oats, Wheat, Red Clover, Alfalfa and Soybeans, Data for 1953 with Summaries of Results from Previous Years," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. 237, April 1954, C. D. Fisher.

"American-Egyptian Cotton Variety Tests, El Paso Valley Experiment Station, 1953," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1708, Sept. 1954, L. S. Stith, P. J. Lyerly, and R. H. Peebles.

"The Effect of Temperature and Rainfall on Peach Production in Northeast Texas," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1709, Sept. 1954, H. F. Morris.

"A Handbook of Agronomy," Agr. Ext. Serv., Va. Polytechnic Institute, Blacksburg, Va., Bul. 97, April 1954.

"Asparagus Culture," USDA, Wash., D. C., Farmers' Bul. 1646, June 1954, R. C. Thompson.

"Factors Affecting Time of Planting Soybeans in the Southern States," USDA, Wash., D. C., Cir. 943, July 1954, E. E. Hartwig.

"Report on the Agricultural Experiment Stations, 1953," USDA, Wash., D. C., R. W. Trullinger.

"Planting the Southern Pines," USDA, Wash., D. C., Agr. Monograph 18, 1954, P. C. Wakeley.

Economics

"Agricultural Science and Its Effect on Civilization," State Dept. of Agr., Tallahassee, Fla., Bul. 152, Jan. 1954, T. J. Brooks.

"An Exploratory Study of Expectations, Uncertainty and Farm Plans in Southern Iowa Agriculture," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 408, April 1954, D. R. Kaldor and E. O. Heady.

"Economics of Grassland Farming," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Spec. Bul. 391, May 1954, K. A. Vary.

"An Economic Appraisal of Beef Production in South Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 518, April 1954, D. W. Parvin.

"Farming Areas in Lewis County, A Statistical Summary by Economic Land Class, 255 Full-time Commercial Farms, Lewis County, New York," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., A. E. 938, April 1954, H. E. Conklin and B. F. Lucas.

"The Farmers Home Administration Approach to Farm Credit Problems," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 388, Jan. 1954, B. H. Kristjanson and J. A. Brown.

"Profitable Milk Production from Grazing Crops, Piedmont Area, South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 411, Dec. 1953, C. P. Butler.

"Costs and Practices in Producing Soybeans in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 412, Jan. 1954, H. L. Streetman.

"1955 Acreage and Marketing Guides," USDA, Wash., D. C., Aug. 1954.

"Corn Acreage, Yield, and Production of all Corn, Corn for Grain, Corn for Silage, and Acreage for Forage, by States, 1866-1943," USDA, Wash., D. C., June 1954.

"Oats Acreage Yield Production, by States, 1866-1943," USDA, Wash., D. C., June 1954.

In offering her offspring a word of advice, a mother said, "Son, from here on never do anything that you would be ashamed for the whole world to see you do."

"Oh boy!" shouted the happy youngster. "Just think, no more baths!"

Speaking from the back of a train, the politician said, "Vote for me and I'll give you better roads; what's more, I'll give you one way streets."

"Won't do no good," interrupted one of the local villagers, "we only got one street in this here town. How'd we get home from where we went?"

Leaf Rust Reaction in Relation to Wheat Fertilization . . .

(*From page* 22)

and discoloration to a lesser degree with the nitrogen applications. Even at Rensselaer where nitrogen was not markedly limiting, a considerable reduction in discoloration occurred with a complete fertilizer and nitrogen plus potassium. Similar modification in symptoms on the susceptible varieties Purkoff and Iobred appeared at Lafayette (Fig. 4).

Due to later maturity, the increased temperature and lower moisture supply in late June and early July were responsible for marked variation in rust symptoms on the susceptible varieties Iobred and Purkoff at Rensselaer. On the upper, especially the flag leaves, all late infection points were surrounded by dead areas. The latest infected leaves did not show uredinia in these necrotic spots, and there were more leaves showing this reaction on plots where the fertilization delayed maturity (Fig. 3). This condition was later produced by artificial, temporary wilting of leaves of different age on the susceptible variety Michigan Amber 29 infected with physiologic form 5. One-half hour in the completely wilted or flaccid condition, with complete recovery following renewed moisture supply, was sufficient to produce this killing effect (Fig. 5). The midday wilting which occurred during the low moisture, high temperature period following the later rust infections was considered responsible for the necrosis symptom on the latest maturing plots at Rensselaer. Kanred and Kawvale, which ordinarily showed considerable discoloration and some killing around infection points, matured enough earlier to miss this period and hence did not show the sharp change in symptoms.

Discussion

Although the fertilizer influences here reported do not show that single factors were responsible for the influences on rust, it appears that the balance of phosphorus and potassium with respect to nitrogen was most closely associated with changes both in amount of rust and the symptom expression. Direct influences of single nutrient elements on amount of rust infection, however, have been reported frequently without qualification. A significant reduction in amount of yellow rust *(Puccinia glumarum)* infection was demonstrated, Doerell (4) and Hieke (6), by application of potassium alone and fertilizer mixtures high in potassium. It can be assumed that these applications were reasonably balanced for their soils since the yield responses were high, but they failed to mention the symptomatic changes in the rust lesions and the relative vegetative characteristics of the high yielding and sparsely rusted plants.

Vigor of host has been considered an indicator of a favorable condition for infection and particularly for the best development of certain rusts and sporulation in specific stages of the life cycle, Arthur (1). This generality does not necessarily apply to instances where single element deficiencies modify growth very slightly without general reduction in the apparent vigor. General vigor, however, without nitrogen overbalance and a resultant high yield of wheat was considered below the optimum condition for infection by stem rust *(Puccinia graminis)* by Stakman and Aamodt (8). Surplus nitrogen with sufficient supply of other elements to produce heavy growth and deep leaf color favored rust infection. In the yield responses, it seemed likely that consideration of a rust-tolerance optimum might show that the reaction type, or combination of types, when several physiologic forms were involved, would account for more influence at a point somewhat below the infection optimum.

The obvious intermixture of physiologic forms in the present study made

detailed accounting of symptoms difficult. The general chlorosis increase with limited nitrogen for the more susceptible varieties associated with lower intensity of leaf color was followed by the development of smaller uredinia, but most of the intermediate reactions could not be compared. The sudden change in symptom, thought related to temporary wilting on the Rensselaer plots, also produced under controlled conditions, Doak (2), might produce an entirely different influence on the maturing wheat plants, and also yield, than the unrestricted rust development and final production of uredinia. Unequal water demands of the rust-infected cells and the adjoining leaf tissues were considered responsible for eventual necrosis. Since the plasmolytic difference would be operative only during recovery from wilting, it can be assumed that the necrotic symptom appeared as the collapsed cells dried over a period of several days. Under conditions in the field as well as with artificially produced wilting, there seem to be no intermediate types of moisture deficiency symptoms.

Most of the modifications in the amount of rust indicated that the fertilizer combinations most favorable for infection also bring about a host response finally associated with the higher yields. An unbalance, however, which may not have marked influence on yield, could produce changed symptoms around the infection points. Detailed study of symptom changes, spore production, and the duration of the living union of rust and host have led to indications of the actual nutrient requirements of the rust. Disconnection and artificial feeding of parts of plants occupied by the rust have furnished some evidence, Mains (7).

It was suggested that some intermediate or transitory compounds, probably carbohydrates, were directly utilized. A combined approach whereby these organic materials were evaluated in connection with mineral nutrient differences affecting rust reaction would

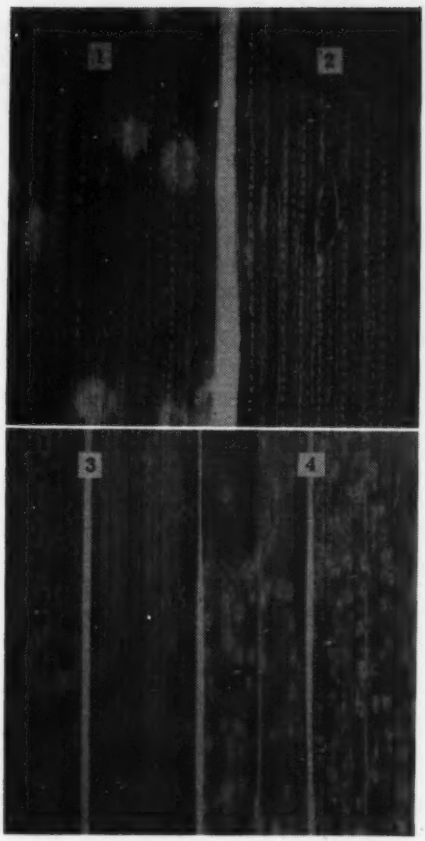


Fig. 5. Effect of wilting on Michigan Amber 29, susceptible to rust physiologic form 5. (1) Typical infection of second leaf on 12th day after inoculation—magnified X14; (2) Necrosis without pustule formation on second leaf on 12th day, wilted on 5th day after inoculation; (3) Reaction of fifth leaf on 12th day after inoculation, showing typical infection; (4) Reaction of fifth leaf on 12th day, wilted on 7th day after inoculation, showing small Uredinia (pustules) in necrotic areas.

give further indications. Though controlled mineral nutrient studies have demonstrated that the reaction symptoms can be changed readily, there has been no indication that minerals in the salts commonly utilized by higher plants can enter into the rust metabolism, Gassner (5), Doak (3). Without understanding more about these relationships, the influences of rust on growth and yield will be difficult to determine. Since the higher yields obtained in the present study seem to be associated with heavy rust infections and symptoms in-

dicating greater susceptibility, it appears that consideration of rust-tolerance factors in the evaluation of yield response would be essential in determining the amount of damage under field conditions.

Summary

Modification in the amount of leaf rust infection was dependent on both the nutrient condition of unfertilized soils and the type of applications. Increase in amount of rust was in general associated with combinations of fertilizer tending toward high nitrogen balance relative to either or both phosphorus and potassium.

Increases in the chlorotic and necrotic symptoms during the growth period of wheat, especially during the period following heading, were associated with low nitrogen relative to either or both phosphorus and potassium. A necrotic symptom following a period of low moisture and high temperature occurred with late rust infections on two susceptible varieties and apparently resulted from one or more periods of temporary wilting.

In a comparison of four wheat varieties differing in rust susceptibility, and during a season of moderately heavy rust infection, general growth responses due to fertilization indicate that rust-tolerance increases as the average expressed symptoms approach so-called high susceptibility. Regardless of the original nutrient balance of the soil at the three locations, these varieties showed high, though not always maximum, yields when the rust reaction approached the most susceptible, and probably maximum rust-tolerant, condition as indicated by the external symptoms. Fertilization practices which result in the most favorable yield response would thus be expected to portend less relative damage by this rust.

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South Carolina's Approach to New Water Management

(*From page* 17)

Such a system should lead to the development of every surface water resource to its fullest potential.

Such a system should also promote wise land development and use. No longer would a user have to own riparian lands to acquire water. A site better suited for a particular use could be developed without regard for its immediate proximity to water. Through judicious allotment of water rights, the Board of Water Commissioners could aid in this development, yet afford adequate protection to existing established uses.

Adoption of legislation such as the proposed bill would mean less waste of the State's water resources. The supplying of a useful industry or a well-recognized want would become the yardstick for allotment of water under the new legislation. No longer would

the use of water be limited by the old rule that the same amount and quality of water now flow through the land. Subject to the judgment of a Water Board, a person might obtain as much water as he needs subject only to provision of water to established uses. In this manner the Water Board could prevent millions of gallons of water flowing unused to the ocean—millions of gallons that in the past served only a few water-users and in the future would serve a great many. By careful planning, a Water Board could permit seasonal storage and orderly withdrawals of water down the length of the stream so that no needed water would flow unused into the ocean. This type of planning, coupled with anti-pollution and other quality controls, would encourage the return of water to streams and rivers for repeated use over the length of the water course. With such a combined quantity and quality law, South Carolina would have a system of apportionment for water that recognizes the changing needs of the times.

Such a law would enable South Carolina or any other state, to marshal its forces for a concerted study and management of its water resources. The technical staff possible on a state level could assemble continually, in cooperation with private and public groups, a wealth of information on water resources and make it available for those who wish to make plans and carry out water conservation programs.

Closely connected to the problem of surface water is that of ground water—nature's underground reservoirs that feed our wells and streams. It is a technical problem, but one that the Water Board's staff could be prepared to handle in due course, after appropriate authorization by the General Assembly.

Soil Tests Are Influenced by Field Conditions . . .

(*From page* 14)

soil as to its flushing effect on the soluble salts. This flushing effect is caused by the surplus water moving down through the surface layer during heavy rains and moving upward again with surface evaporation, leaving the dissolved salts at or near the surface. These salts influence the conductivity of the soil and the test for certain soluble elements, and usually lower the pH. This influence will be greatest where there is an accumulation of fertilizer salts in the soil. Thus the possible influence of fertilizer salts should

TABLE II.—THE INFLUENCE OF RESIDUAL FERTILIZER SALTS ON SEVERAL OF THE SOIL TEST READINGS

Plot No.	Salt Concentration*			pH Reading			Nitrate Reading**		
	A	B	C	A	B	C	A	B	C
1	45	26	180	5.5	5.5	4.7	11	9	63
2	41	26	135	5.9	5.8	5.0	13	9	63
3	41	26	125	5.9	6.1	5.1	11	6	46
4	70	23	180	5.7	5.8	4.8	11	8	78
5	45	30	120	6.1	6.1	5.2	13	11	42
6	60	30	180	5.4	5.4	4.8	13	12	58
7	48	37	180	5.8	5.8	5.0	15	13	78

* Micromhos (Specific Conductance), with a soil-water ratio of 1:1.
** Parts per million in air-dry soil.

be taken into consideration more in the summer and fall than during the winter and early spring. For this reason we recommend that most of the sampling be done in January, February, and March before spring fertilizer has been applied and after most of the soluble salts from the previous year's fertilization have been removed from the soil by the winter cover crops. At this time of year the amount of moisture in the soil at time of sampling will make little difference in the soil test.

The samples of soil for the analyses shown in Table I were taken from a 25 X 30 foot block of land on the sampling dates shown. The soil was a Sassafras sandy loam. No fertilizer was added and no plants were grown on the soil. As the data indicate, there was no seasonal fluctuation in pH; and where there was a lowering of the pH, it was accompanied by an increased salt concentration and a corresponding increase in nitrates. This movement of soluble salts in the soil and its influence on the soil tests should be considered at all times by those taking samples and making recommendations.

Samples B and C (Table II) were taken from potato plots the day of digging. The B samples were taken before digging from between the rows largely away from the fertilizer influence, while the C samples were taken in the row behind the digger. The marked differences in the readings give some idea of the difficulty of getting a representative sample under such conditions and the possibility of getting an erroneous picture of the soil fertility. The A samples taken in February before potatoes were planted or fertilizer added show tests similar to the B samples taken in July between the rows.

TABLE III.—THE INFLUENCE OF A ONE-TON-PER-ACRE APPLICATION OF HYDRATED LIME AND FINE AND COARSE LIMESTONES ON THE SOIL REACTION OF FIVE COASTAL PLAIN SOILS (SURFACE AND SUBSOIL)

Soil type	pH before lime added	Hydrated lime		Limestone			
				Fine*		Coarse*	
		2 wks.**	48 wks.**	2 wks.**	48 wks.**	2 wks.**	48 wks.**
Sassafras Sandy Loam							
Surface	5.4	7.4	6.7	6.4	6.1	6.1	5.8
Subsoil	4.9	7.7	6.9	6.6	7.0	6.0	6.3
Lenoir Silt Loam							
Surface	5.2	7.3	6.8	6.5	6.6	6.0	6.0
Subsoil	5.1	6.9	5.9	6.4	6.1	5.8	5.5
Bayboro Silt Loam							
Surface	5.0	5.6	5.3	5.3	5.0	5.3	5.1
Subsoil	4.6	5.4	5.0	5.2	5.1	5.0	4.8
Bladen Silt Loam							
Surface	6.0	7.8	7.1	7.1	7.0	7.0	6.8
Subsoil	5.0	6.7	6.0	6.3	6.2	5.6	5.6
Norfolk Fine Sandy Loam							
Surface	5.8	8.3	8.0	7.1	7.2	7.0	6.8
Subsoil	5.5	8.1	6.4	7.6	7.3	7.5	6.2

* Fine limestone 80% through 200 mesh, coarse limestone 56% through 60 mesh.
** Soils wetted to 25% above moisture equivalent once each week.

The time, type, amount, and method of previous application of lime can influence the soil test. If the lime is not thoroughly mixed with the soil, and this usually takes several years, it is impossible to get a true picture of the soil reaction.

Table III shows the influence of three commonly used liming materials on the soil reaction of five coastal plain soils after 2 and 48 weeks where the lime was thoroughly mixed with the soil when applied. Note that in practically all cases the limestones were as effective in raising the pH after 2 weeks as after 48 weeks. This indicates that the opinion held by some that the limestones must remain in the soil several months before they become effective is not true.

Fertilizers Increase Yield and Protein Content . . .

(*From page* 12)

It appears, therefore, that the farmer who grows corn for silage need not fear that the use of fertilizer will lower the feeding value of his silage.

Does Fertilization of Silage Corn Pay?

Will it pay to use fertilizers in growing my silage corn? This is a ques-

TABLE I.—YIELDS OF CORN FORAGE AS DETERMINED FROM FIELD SAMPLES AND FROM COMPLETE HARVEST OF UNFERTILIZED AND FERTILIZED BLOCKS

Date of harvest	Unfertilized			Fertilized		
	Fresh matter	Dry matter	Dry matter	Fresh matter	Dry matter	Dry matter
	lb.	*perct.*	*lb.*	*lb.*	*perct.*	*lb.*
Sept. 4, 1947[a]	19,490	19.5	3,800	21,580	19.6	4,230
Sept. 15, 1947[a]	20,590	25.4	5,230	22,190	25.1	5,570
Sept. 22, 1947[a]	20,290	27.8	5,640	21,780	27.6	6,010
August 24, 1948[a]	36,020	22.6	8,140	39,040	21.9	8,550
August 31, 1948[a]	34,210	27.1	9,270	39,290	25.2	9,900
Sept. 7, 1948[a]	32,800	31.8	10,430	35,210	31.1	10,950
August 16, 1949[a]	33,850	20.0	6,770	39,510	20.3	8,020
August 23, 1949[a]	32,340	23.1	7,470	36,550	23.5	8,590
August 30, 1949[a]	32,070	27.1	8,690	36,860	27.1	9,990
Sept. 1, 1949[b]	30,400	27.6	8,390	34,510	27.5	9,490
August 29, 1950[a]	22,560	21.5	4,850	31,110	21.6	6,720
Sept. 5, 1950[a]	22,300	23.5	5,240	31,550	23.3	7,350
Sept. 12, 1950[a]	22,670	26.6	6,030	31,120	26.9	8,370
Sept. 13, 1950[b]	20,000	26.6	5,320	29,090	26.5	7,710
August 21, 1951[a]	24,980	20.7	5,170	32,650	20.4	6,660
August 28, 1951[a]	26,830	20.5	5,500	36,460	20.6	7,510
Sept. 4, 1951[a]	27,080	25.3	6,850	35,410	24.2	8,570
Sept. 12, 1951[b]	22,020	28.2	6,210	29,110	28.0	8,150

[a] Determinations based on field samples.
[b] Determinations based upon complete harvest. An adjustment was made in the yield to take into account the forage removed in sampling.

tion which each person must decide for himself after obtaining the necessary information. As brought out in the foregoing discussion, the application of fertilizers brought about only small increases in forage yields when the crop was grown on a field already well supplied with plant food. On the other hand, fairly large increases were obtained when the fertilizers were applied to poor soil. Obviously, careful soil tests are indicated as a first step unless the productivity of a field is already known.

It may be calculated from the figures in Table I that in the experiment reported here, the increases in fresh forage which resulted from fertilizer use were, in the successive years: 1,490 lbs.; 5,080 lbs.; 4,780 lbs.; 8,450 lbs.; and 8,330 lbs. While market prices change from year to year, the cost of 200 pounds of 8-8-8 and 200 pounds of nitrogen fertilizer may be roughly estimated at $15 to $20. Using an estimated value for corn forage of $8 to $10 a ton, it is apparent that an increase of three fourths of a ton of forage would not pay for the cost of fertilizer. On the other hand, the increase of more than 4 tons of forage which was obtained in each of the last two years when the corn was grown on poor soil would give a handsome profit. Then, too, during these two years, the protein content of the leaf-stalk portion of the forage was also increased—an item of value to the livestock feeder.

Summary and Conclusions

A five-year investigation was conducted to determine the effect of fertilizer application at planting time followed by sidedressing with a nitrogen fertilizer at the last cultivation on the yield and composition of hybrid corn grown for silage. Five hybrids known to be high yielding for both grain and forage were employed.

Under the conditions of this trial, the application of fertilizer to soils for the production of corn forage resulted in: (1) gains in tonnage of forage as represented by both ear and leaf-stalk fractions; (2) little or no change in the proportion of forage which consisted of ears; (3) little change in the protein content of the shelled corn except as influenced by season; (4) an enhanced protein content of the leaf-stalk fraction of the forage when the crop was grown on soils low in available plant food; and (5) little change in the fiber content of the forage.

(This article is a digest of Bulletin 577, "Yield and Composition of Corn Forage as Influenced by Soil Fertilization," published by the Illinois Agricultural Experiment Station. The bulletin was prepared by K. E. Harshbarger, W. B. Nevens, R. W. Touchberry, A. L. Lang, and G. H. Dungan).

Four Tons Alfalfa from Seven-year-old Stands

NOBODY would expect seven-year-old stands of alfalfa to produce much hay. But O. J. Attoe and Emil Truog, Soil Scientists at the University of Wisconsin, harvested alfalfa each year from seedings made in 1947, and still got as much as four tons to the acre each year.

The research men say the secret to such success with alfalfa is the right amount of liming and fertilizer. Tests were carried out in Barron County on Spencer and Antigo silt loam soils.

The tests began in 1942 with application of 1500 pounds of 0-20-20 on each acre to bring the fertility level up to about 75 pounds of available phosphorus and about 200 pounds of avail-

able potassium per acre. Five to 10 tons of lime to the acre corrected soil acidity.

In the next five years the fields followed a rotation of corn, oats, and two years of hay. With oats, the fields got 300 pounds per acre of 0-20-20 broadcast and another 200 pounds per acre drilled with the seed.

The rotation was discontinued in 1947, and the fields have been in alfalfa since then. A topdressing of 200 pounds per acre of muriate of potash was put on in the fall of 1950, 1951, and 1952. Some plots were left unfertilized and unlimed to serve as comparison plots.

Cossack alfalfa was used in these tests, as there is no wilt problem in Barron County. However, Attoe says that with an adapted variety—wilt resistant if necessary—together with a good fertilization and liming program on soil at least fairly well drained, these results could be duplicated anywhere in Wisconsin.

Lime and fertilizer costs for the six years of continuous alfalfa production have run about $75 an acre. During this time, some 22 tons of alfalfa per acre were taken from the field. This means the cost of lime and fertilizer was only about $3.40 per ton of hay. Farmers who use manure on their fields could lower this cost, the researchers say. Because of the carry-over effect of the lime and fertilizer, cost of establishing alfalfa on these fields in the future shouldn't be more than about one third the cost of the original establishment, Attoe and Truog say.

The tests have also shown that lime increases the availability of phosphorus naturally present in the soil. Because of this, the researchers say that 1,000 pounds per acre of 0-10-30 would do the job as well as 1,500 pounds of 0-20-20. This would reduce the fertilizer cost about 40 per cent.

Test Soil Before Topdressing Alfalfa

TEST your soil before you apply fertilizer topdressing to your alfalfa fields. Tests will show whether your soil needs the fertilizer and will also serve as a guide to the kinds and amount of plant food needed.

Many soils do not have enough plant food to grow good alfalfa, according to C. M. Linsley, Extension Soils Specialist at the University of Illinois College of Agriculture. Where fertilizers have not been applied before the alfalfa was seeded, they can be put on after the first cutting has been removed. This topdressing will usually give yields a good boost.

Fields that need potash can be topdressed safely after a cutting has been removed, Linsley says. The potash will not burn the new growth if the leaves are dry. If leaves are wet with dew or rain, however, some of the potash will stick and burn spots on them.

Phosphorus applied after the first cutting will also give a worth-while increase in yield on soils needing phosphorus. But it will not give as good results as when applied ahead of the seeding

Alfalfa will not need nitrogen fertilizers as a topdressing, Linsley says. Alfalfa serves as a nitrogen factory and will fix much of the nitrogen it needs from the air. If nitrogen fertilizers are added, however, the legumes will use this nitrogen rather than fixing the nitrogen from the air.

There is no one fertilizer that is best to use for alfalfa in all cases, Linsley advises. Your soil tests will tell you the best kind of fertilizer for your alfalfa, and also the amounts needed.

Land! Water! People!

(*From page 26*)

ment Station are typical of what is being done by experiment stations generally. Already worth-while results have been secured in the South Carolina tests, for in a period of three years the yield of corn was more than doubled, and cotton and tobacco yields increased 41 and 44 per cent, respectively, from additional water applied to the growing crops.

The South Carolina Extension Service, through its corps of trained specialists and county agents, is rendering great service to farmers by taking to them the results of this research through demonstrations in the proper use and conservation of water. The activities in South Carolina have been greatly encouraged by grants made to Clemson College by W. B. Camp, a native son of the State and graduate of the institution, who migrated to California some years ago where he became a highly successful farmer.

Farmers cooperating with soil conservation districts are demanding more and more assistance from soil conservation technicians assigned to cooperate with and assist districts with their soil and water conservation problems.

In the Lancaster (South Carolina) District, for instance, there had been constructed up to June 30, 1954, a total of 763 farm ponds of all kinds. But during the month of July, largely as a result of the unprecedented drought, 35 more were built under the direction of technicians assisting the district. Think of it, almost 5 per cent as many built in one month as in the several years the district has been in existence!

In recent months the calls for assistance in the solution of water problems —largely to locate and develop sources of supply for stockwatering and for irrigation—have been so great as to reduce materially the assistance soil conservation technicians could render in other types of soil and water conservation.

The concern of farmers and others about these problems is resulting in the development of interest in modernizing state water laws throughout the country. Many states are giving attention at this time to the inadequacy of their present laws now that water has assumed such an important place in our economy. Soil conservation district supervisors have taken the lead in many states in this movement. They have had the assistance of numerous federal, state, and local agencies and groups.

We have plenty of water in the humid regions of our country if we can just learn how to use it. And the supply is being constantly replenished through rainfall. With an average rainfall up to four feet—enough to swim in—on every acre of land in the eastern part of the United States, there should be no shortage of water. And there will be none if we but recognize the need for action and plan accordingly. We must learn to store water when it is in abundant supply so that it will be available when needed later on. Water can be stored within the soil by proper treatment and management to increase its absorptive power. Also, it can be stored above ground in properly constructed artificial ponds or lakes.

The unplanned, uncoordinated, and unrestricted use of water will lead to difficulty just as will the unwise use of any natural resource. Let us recognize, therefore, our dependence upon water, even as we recognize our dependence upon the land. Both must be conserved for our use when and as needed. We must realize that without a productive soil, abundantly watered, we cannot continue to eat well, cannot continue to have plenty of clothes to wear, cannot continue to exist as a strong and vigorous people.

Drought

(*From page* 8)

tility and (b) excesses of temperature. When they are the latter they represent little that we can do to offset the damage. As the former, or shortages of fertility, their disasters are not necessarily mitigated if we merely apply water. Soils made both deeper in structure required for water storage, and more fertile also to that depth, will lessen the damage in the drought years but will also give bigger yields in years of no drought. When once we appreciate the soil as a factor in the drought, then we can use the years of no such damage to build the soil fertility for less of disaster from the drought when it occurs. Fertility is the major means of managing the soil to mitigate drought damage, and to give bigger returns in crops also when there is no drought.

Heat Wave Is Disaster to Animals Also According to Their Nutrition

The heat wave of 1954 was disastrous to animals in Missouri as well as to plants, according to the reported deaths of poultry and rabbits from the excessive temperatures. The mounting temperatures correlated with increasing numbers of deaths of experimental rabbits on grain coupled with hay grown on soil of different treatments suggested that the nutrition of the animal and not the high temperature per se is the factor in the fatalities associated with the heat.

Seven lots of nine rabbits each, separated from the larger original stock, were fed on wheat of a single lot and on timothy hays grown on soil given different treatments. These were: (1) Full fertilizer treatment; (2) this supplemented by copper; (3) by boron; (4) by cobalt; (5) by manganese; (6) by zinc; and (7) by all these trace elements.

With the mounting temperatures of the drought and heat wave, many of the experimental rabbits died and replacements were made from the remaining original lot (which had suffered no heat fatalities) at the weighing date after a fortnight. Those in the original lot were fed on the same wheat as the experimental lots, but the roughage of the former was green grass growing on soil fertilized with rabbit manure. During the period June 11 to July 17, 1954, a total of 57 rabbits died on the timothy-wheat ration, while in the same room there were no deaths of the original lot remaining on their wheat-grass ration and tolerating the same heat wave. This represented maxima ranging from 88 to 113°F. and a mean maximum of 99.4 degrees during the fortnight closing with July 17.

On that date the wheat-timothy hay ration was supplemented with 10 gm. per rabbit per day of commercial dried milk powder. No more deaths occurred during the extension of the experiment for nine more days. During that time maximum daily temperatures ranged from 89 to 111°F. with a mean maximum of 98.2°F.

A repeat of this test was started July 26 using corn, oats, and wheat in equal parts by weight along with the same timothy hay. This trial exhibited again the fatalities with the high temperatures until August 23 when the feeding of the timothy hay was discontinued and replaced by red clover hay. No deaths occurred during the extension of the test with red clover hay from August 23 to September 6, during which the maxima of temperatures ranged from 79 to 102° with a mean maximum of 97.6 for those 14 days. For the fortnight preceding the date of change to red clover, the maxima ranged from 70 to 98°F. with a mean maximum of 82.5° F. With the close of this test there were still eight rabbits left of the original lot kept on the wheat-grass ration

during the entire summer among which no fatalities whatsoever occurred as a result of the heat wave of record-breaking temperatures.

These disasters, ascribed to drought as mainly a water shortage in the soil allowing the increasing insulation to raise the temperature to excessive degrees, represent differing fatalities according to nutrition of either plant or animal. They suggest hope in our efforts for their mitigation in some degree, when viewed less as rainfall shortage and heat waves beyond our control and more as nutrition coming via the soil.

Watersheds

(*From page* 5)

federal forces in respect to advancing plans. All this and a bit more red tape must be unraveled before any actual spade work is started. First, the kinds, amounts, and costs of proposed works must be mutually agreed on between the parties to the deal and the USDA technicians. Second, when this is completed, they get together again and try to agree on some division of the expected costs. There seems to be no figure given in percentages covering the allowable shares to be borne by either the federal government or the local watershed group

But this isn't the end of the cautious approach to real business. Third, when these shares are agreed upon and the preliminary work plan is o. k., the whole thing is submitted to the chief of the Soil Conservation Service. He is required to throw the whole plan open to inspection and appraisal at the hands of the U. S. Army engineers and the specialists in reclamation in the Department of the Interior. They have 60 days to look into it. Then not to be caught short, the plan is also sent to the state agency or the governor to review it again.

When the "tattered" plan bearing numerous thumb prints is at last bundled back to the desk of the Secretary of Agriculture (or some man Friday who represents him) what happens to it? After a leisurely inspection to see that all the dots are dotted and all the p's and q's are legible, and all important signatures are affixed, the fellow who bears this end of the load for Mr. Benson quietly sends it on to the White House. After a brief interval, the President's staff makes note of it for their files and probably keeps a duplicate copy, and then forwards the whole shooting match on to Congress.

Still it's not through the woods yet. The law says that 45 days of official Congressional session must pass by before any watershed jobs that involve the use of federal funds may be undertaken.

The matter of making legal contracts bobs up as a puzzle in some respects. It isn't feasible to plunge ahead anywhere unless this question of legal contract rights is secure. Not all states permit soil conservation districts or similar quasi-public groups to enter into contracts for building dams and reservoirs. Hence the state's attorney-general will often be asked to look at this situation first. Several states, it is believed, must get busy and pass some new enabling laws if the watershed projects are to be undertaken.

If they do possess the contractual power, they are obliged to use the same basis for bidding as the USDA provides. All contract work must be done according to specifications fully approved by USDA people, and not a cent of money will be paid to contractors for unauthorized work or any jobs performed outside of the approved contract terms.

Now for the other law, the one that touches the individual farmer who wishes to do his part to help improve the water conservation picture and at the same time make his farm more productive. The fact that this law provides for the insurance of all approved loans by the Farmers Home Administration encourages the advent of private capital into conservation measures and reduces the reliance upon the funds of the federal government.

It has been pointed out that based on experience with such legislation in 17 Western States, the rate of repayment of such loans will be fairly high. As of last June, they report, nearly eleven million dollars had come due in this way, and slightly over eleven million had been received from borrowers.

WHO gets these loans is something that the wisdom and judgment of the three FHA committeemen in every county must determine. At least two out of the three must be active farmers.

Their task is not entirely an easy one. Just because they know the applicant by his first name or went to school with him away back when—that's no criterion. The one who gets the loan must be known by the committee to be enough of a farmer to indicate he has fairly sound prospects of handling the operations well. But the main idea is to locate a farmer who possesses such practical qualifications but who cannot get the credit advanced to him locally from private and cooperative sources on fair and reasonable terms. No doubt this ruling will admit lots of young fellows with good farm backgrounds who have not established credit with their lending agencies.

As a sort of side issue, loans are also open to nonprofit associations that are mainly engaged in furnishing their members services related directly to soil conservation, or forms of water conservation, including drainage.

When the FHA committee nods its

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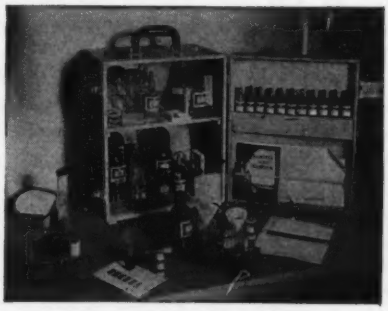

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approval, the borrower signs certain hefty documents as usual and takes his loan from the bank, fully insured. He may dip into it to pay cash for his materials, equipment, and hired services insofar as they apply to the establishment of soil and water conservation practices.

SOME of the jobs to be undertaken with these loans would include building or repairing dikes, terraces, and ponds, the renovation and fertilizing of pastures, tree planting and similar combined soil-water conservation measures; and for purely water conservation matters, such items as tanks, cisterns, wells, irrigation and pumping apparatus and the like.

No annual recurring operating costs for farming are to be recognized under these loans. It won't be permissible, for example, to buy and apply fertilizer and lime in the growing of any regular food and feed or fiber crops, and draw on the loan to pay for it. Neither may any of this loan money be used to settle some prior debt or any existing notes.

The official rate of interest chargeable to a borrower on the insured loans is four per cent on the unpaid balance of the principal. He will also be asked to pay in advance each year a charge of one per cent as the loan insurance coverage, also based on the unpaid principal.

The outlook seems to be that ample private credit will be available in most states to satisfy the likely demand by farmers for the maximum amount that the law allows to be loaned each year, or twenty-five million dollars.

When a borrower is able to refinance his loan on the basis of the remaining unpaid balance, he will be expected to try and get this done through private sources at reasonable terms. From experience it is felt that the average individual loan will be somewhere near $3,000 to $5,000, and those for associations probably about ten or fifteen times as much—with a loan limit to them of $250,000. No individual farmer may get more than $25,000.

It is understood that sound farm and home plans will be mixed into this picture to some extent for those who get loans for major farm adjustments. At any rate, the borrower is not apt to try to rely on his own knowledge and skill to install the improvements he contemplates to put in with his loan. This means he will stick fairly close to the types of soil and water conservation practices which have been tested and recommended by the State Extension Service and the Soil Conservation Service.

It will take time. All these well-visioned ways to get the kind and scope of solid and lasting conservation measures into being should, if well managed, add much to our natural resources. They aim to save farms and forests and stop floods. They may represent a great step forward for this generation.

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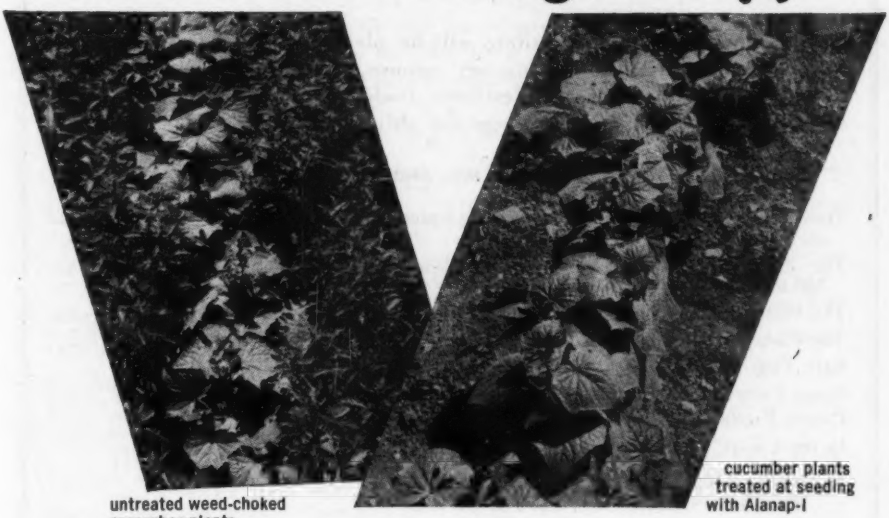

untreated weed-choked cucumber plants

cucumber plants treated at seeding with Alanap-1

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Extensive field tests prove that Naugatuck's new herbicide, Alanap-1, can save growers of cucumbers, melons and squash countless dollars by practically eliminating hand weeding.

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FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Reprints

28-12-45 Better Corn (Midwest) (Circular)
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
I-2-47 Fertilizers and Human Health
T-4-47 Fertilizer Practices for Profitable Tobacco
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48 Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
SS-12-49 Fertilizing Vegetable Crops
BB-8-50 Trends in Soil Management of Peach Orchards
I-2-51 Soil Treatment Improves Soybeans
X-8-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
E-2-52 Ladino Clover—Its Mineral Requirements & Chemical Composition
H-3-52 The Relative Merits of Inorganic & Organic Sources of Plant Nutrients
O-4-52 Tomato Production for the Canning Industry
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
I-2-53 Sericea Is a Good Drought Crop
J-3-53 Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53 Kudzu Keeps Growing During Droughts
N-4-53 Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
P-4-53 Learning How to Make Profits from Sweet Potatoes
S-5-53 More Cotton on Less Land
T-5-53 Trefoil Is Different
W-6-53 The Development of the American Potash Industry
AA-8-53 Strong Roots Make High Corn Yields
DD-10-53 Sampling Soils for Chemical Tests
FF-10-53 Testing and Reclaiming Alkali Soils
II-11-53 The Importance of Legumes in Dairy Pastures
JJ-11-53 Boron—Important to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
B-1-54 High-level Fertility Makes Balbo Rye Roots More Effective
C-1-54 Soil Test Summaries Can Be of Value to Many Groups
D-1-54 Relation of Potash and Phosphate to Cold Injury of Moore Pecans
I-2-54 Lime and Fertilizer Pay Off
J-2-54 Feed in the Northeast—Buy It or Grow It?
K-2-54 Soil and Plant Analyses Increase Fertilizer Efficiency
L-2-54 Alfalfa Regains Favor With Tennessee Farmers
M-3-54 Peanut Production Trends in North Carolina
Q-3-54 Fertilize By Test—Not By Guess!
R-3-54 Soil Fertility (Basis for High Crop Production)
S-4-54 So You Want to Grow Alfalfa?
T-4-54 The Fertilization & Liming of Pennsylvania Fruit Soils
U-4-54 Nutrient Balance Affects Corn Yield and Stalk Strength
V-4-54 Tung Culture Finds a Place in South Mississippi
X-5-54 Fertilizer Analyses Are on the Move—UPWARD
Y-5-54 Potential of Fertilizer Use for More Efficient Production as Applied to Midwest
Z-5-54 Oregon Can Produce More Strawberries
AA-5-54 The Changing Fertility of New England Soils
BB-6-54 Potash Pays on Forage in New England
CC-6-54 Fertility Increases Efficiency of Soil Moisture
DD-6-54 Surveying California Citrus with Leaf Analysis
EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
GG-8-54 Effect of Boron on Beets and Crops Which Follow
HH-8-54 Soil Testing and the Land-Grant Colleges
II-8-54 Early and Delayed Grazing of Alfalfa Orchardgrass and Ladino Clover

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The ladies met on a train. "I'm from Boston," haughtily remarked one. "There, breeding is everything."

"Well, I'm from St. Louis," the other replied. "We like it there, too, but it's not everything."

* * *

Clancy came home from church on Sunday, and upon checking over the cash in his pockets, yelled to his wife, Maggie, and said: "I've made a terrible mistake. I put a five dollar bill in the church collection, thinking it was a one."

Grabbing his hat he started for the door. "I'll go and ask Father Murphy to give it back to me," he shouted.

His faithful better half followed and comforted him. "Don't do it, Clancy," she said. "You gave it for a good cause, so now t'ell wit it."

* * *

"I'd ask you for this dance," said the sailor, "but all the cars are occupied."

* * *

Two Irishmen, meeting one day, were discussing local news.

"Do you know Jim Skelly?" asked Pat.

"Faith," said Mike, "an' I do."

"Well," said Pat, "he has had his appendix taken away from him."

"Ye don't say so!" said Mike. "Well, it serves him right. He should have had it in his wife's name."

The circuit rider was asking the hillbilly girl if he could speak to her father.

"Naw, sir," said the girl, "Daddy's in the pen."

"Well then," said the minister, "What about your mother?"

"Mamma's in the county sanitorium," said the girl, "she was seein' things."

"Perhaps I could speak to your brother," said the minister.

"Naw," said the girl, "he's away at Harvard."

"Oh," said the minister, brightening, "That's fine, what is he studying?"

"He ain't studying nothin," said the girl, "they're studying him."

* * *

He—"You have the most adorable eyes."

She—"Yes, go on."

He—"And the most adorable neck."

She—"Yes, go on."

He—"And the most adorable pair of—"

She—"You have gone far—"

He—"Arms."

* * *

Company Officer: "You are charged with using insulting language to your sergeant."

Private: "Sir, I was only answering a question."

"What question?"

"He said, 'What do you take me for?' and I told him."

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Contains a higher percentage of available boron than any comparable agricultural borate on the market . . . 20.5% Boron or 66% B_2O_3. This material should be applied as a spray or dust, directly to the foliage of crops. Polybor-2 is compatible with insecticides and fungicides currently in use and may be applied in the same solutions in the established routine culture of crops. Send for Bulletin PF-4.

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